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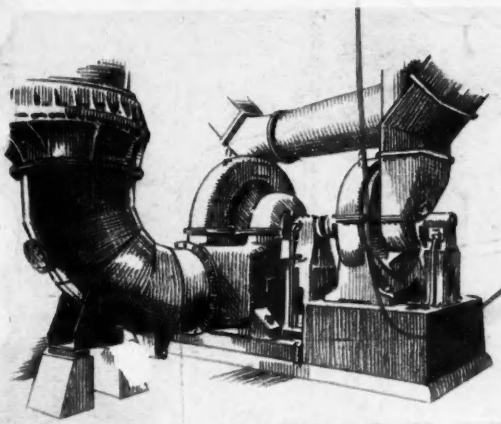

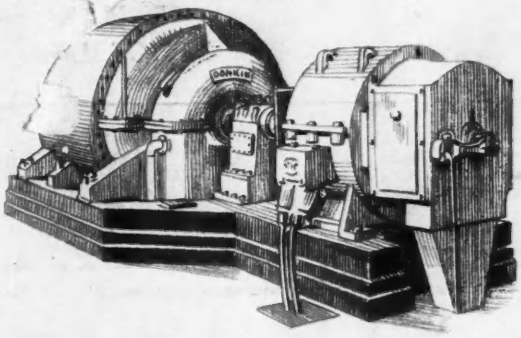

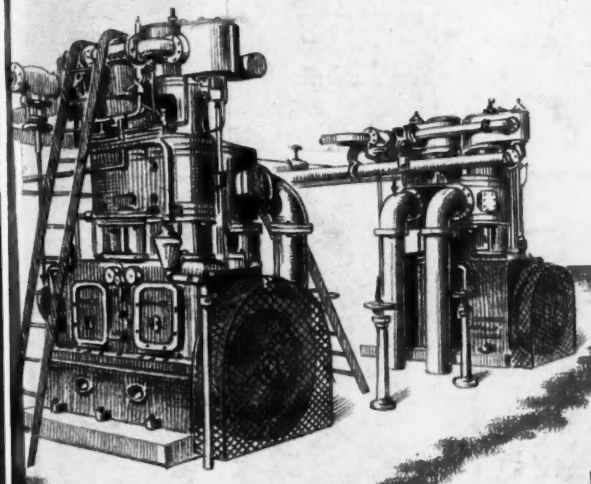

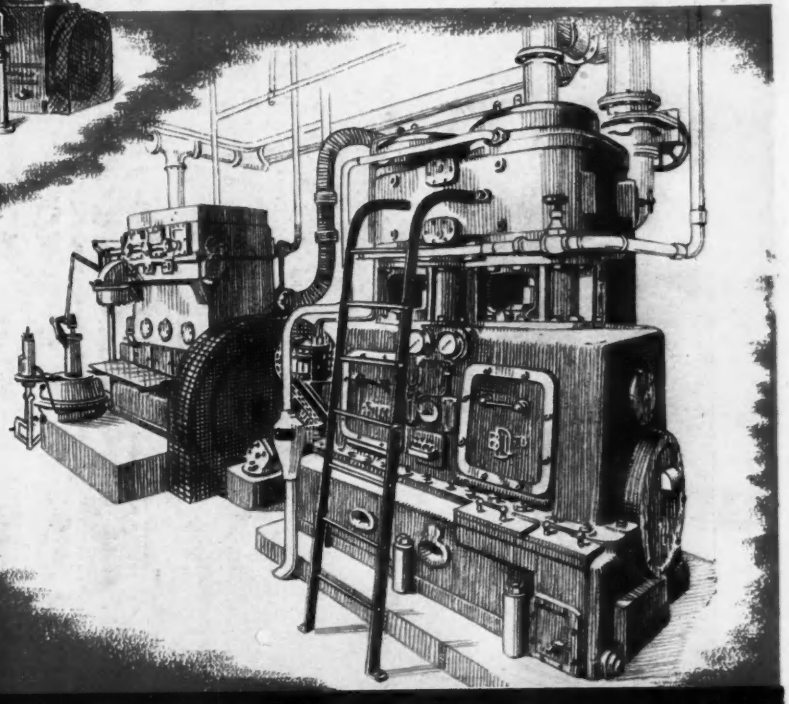

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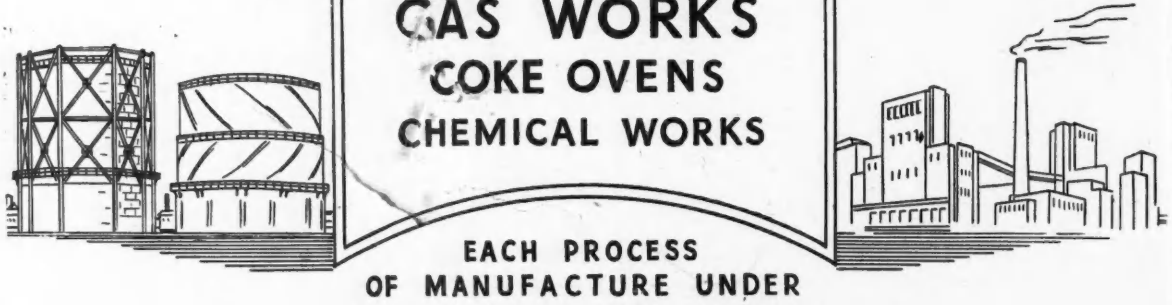

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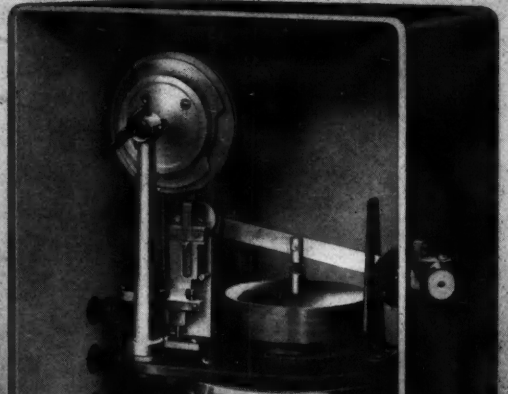

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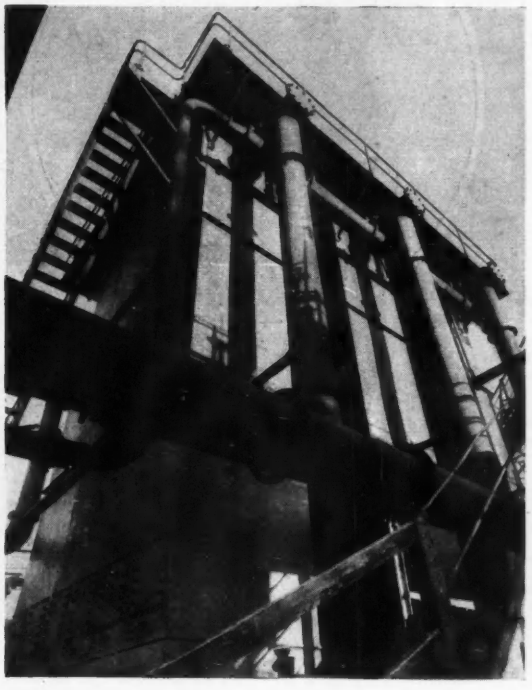

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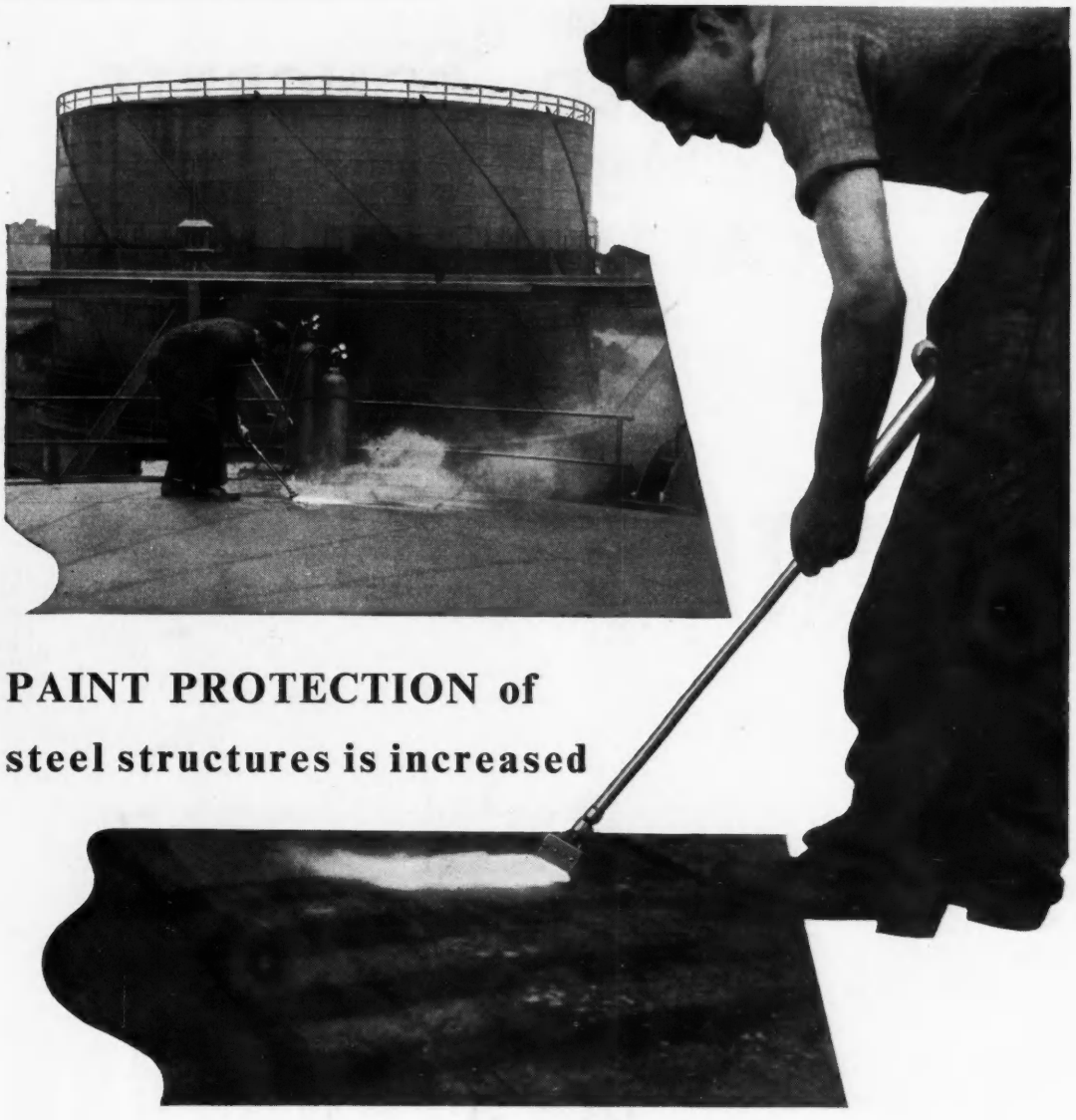

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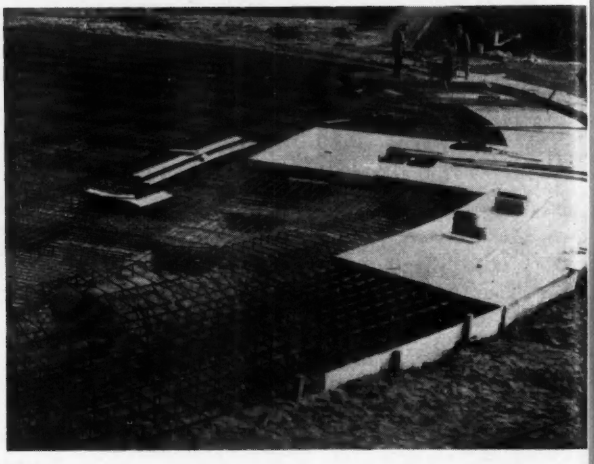

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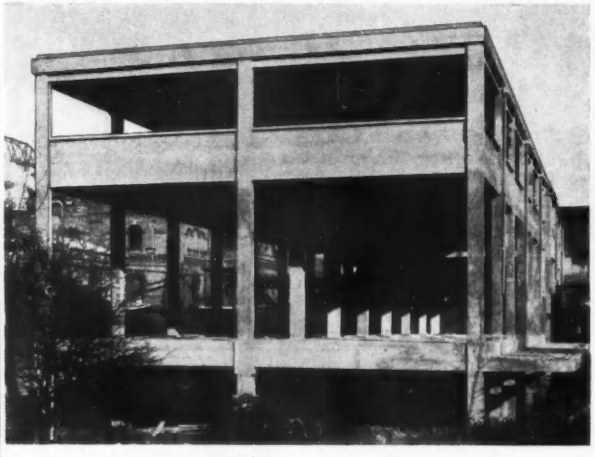

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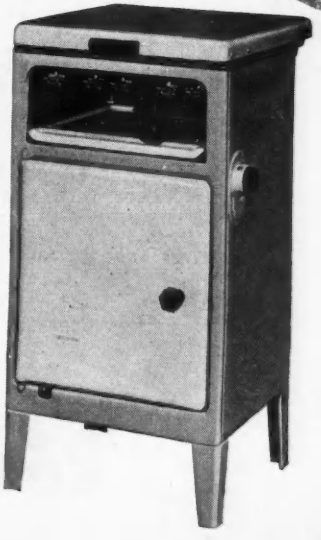

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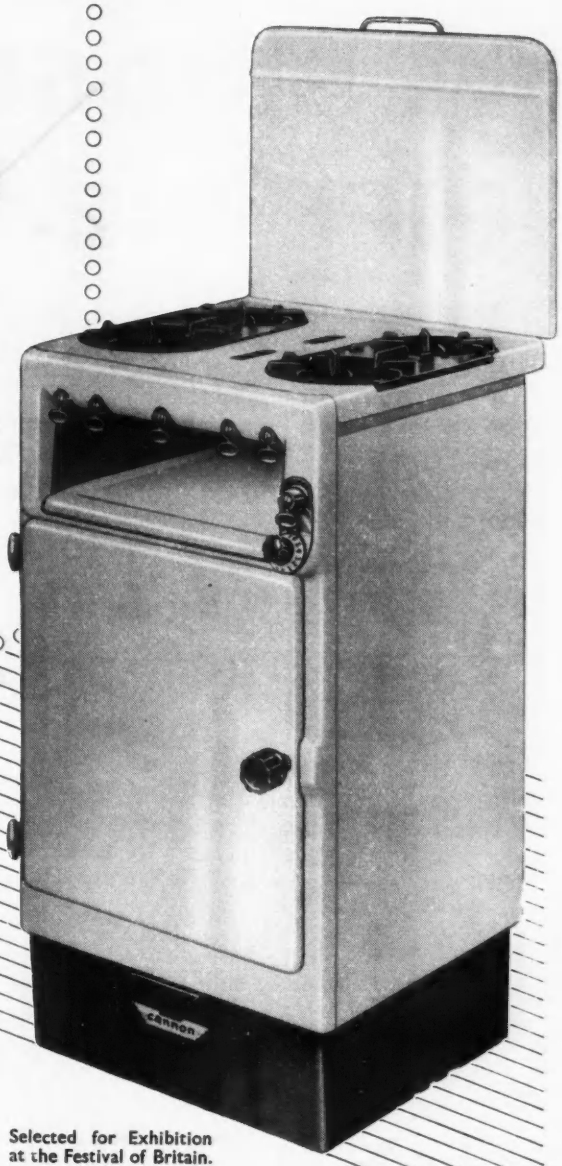

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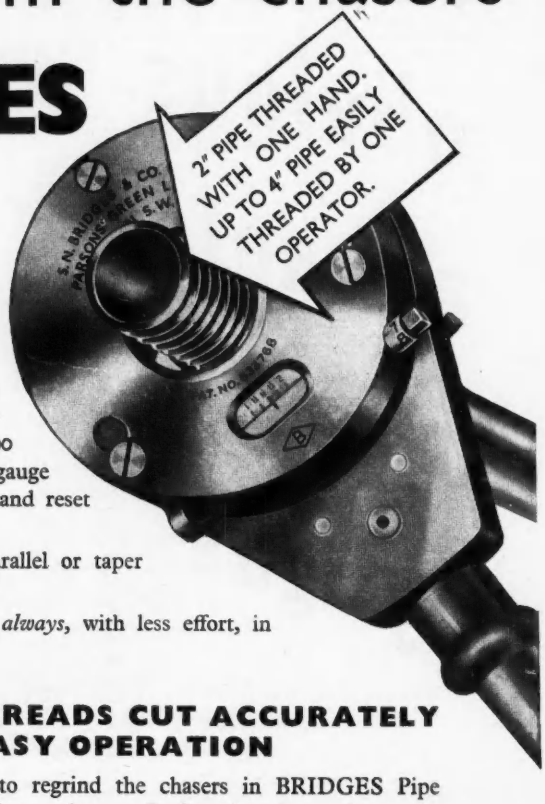

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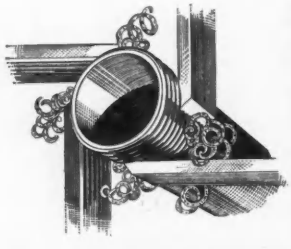

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Paisley	5
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Dunfermline	2
Sedgley	1
Arbroath	1
Salford	13
Dumbarton	12
Stockton	11
Coventry	11
St. Albans	9
Denton	5
Perth	4
Carlisle	2
Peterhead	2
Blyth	2
Stirling	1
Leamington	1

ORDERED BY Messrs. WEST'S GAS IMPROVEMENT CO LTD

ORDERED BY Messrs. W. J. JENKINS & CO LTD

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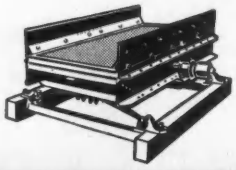
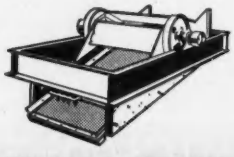
Bath	6
Chelmsford	6
Wrexham	3
Scarborough	3
Prescott	2
Llanelly	3
Armadale	2
Barrow-in-Furness	2
Galashiels	1
Leyland	1



For full details of Pegson Coke Screens, please write for a copy of the latest leaflet which contains useful plant layouts incorporating these screens.



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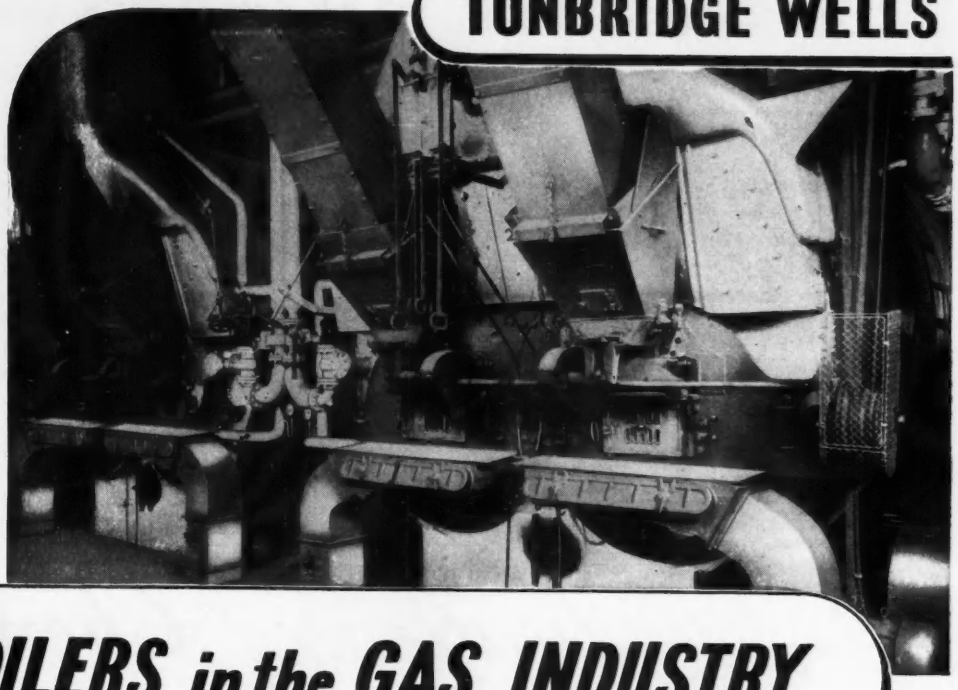

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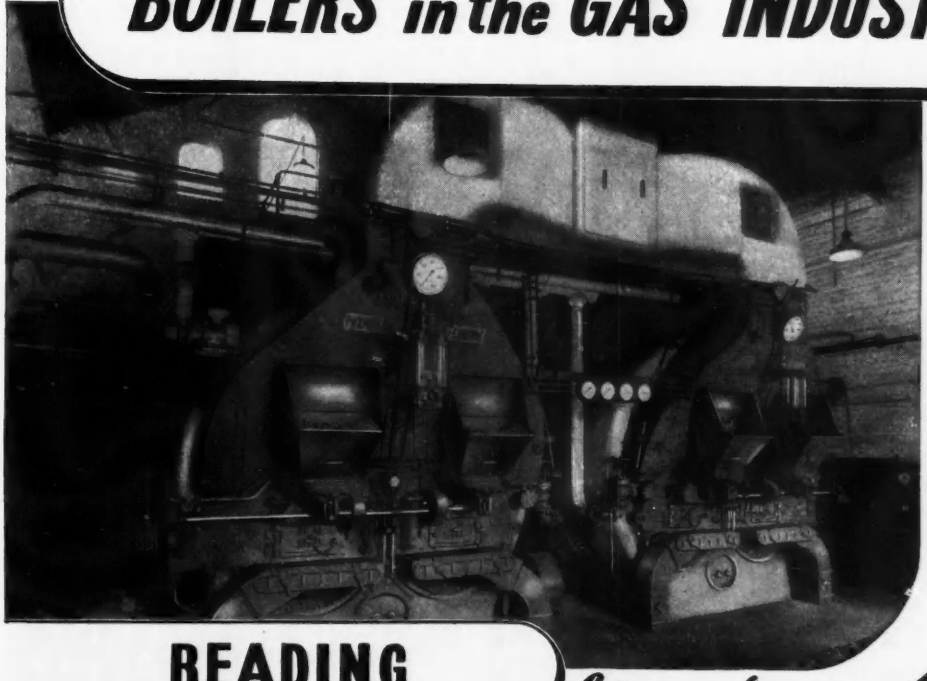

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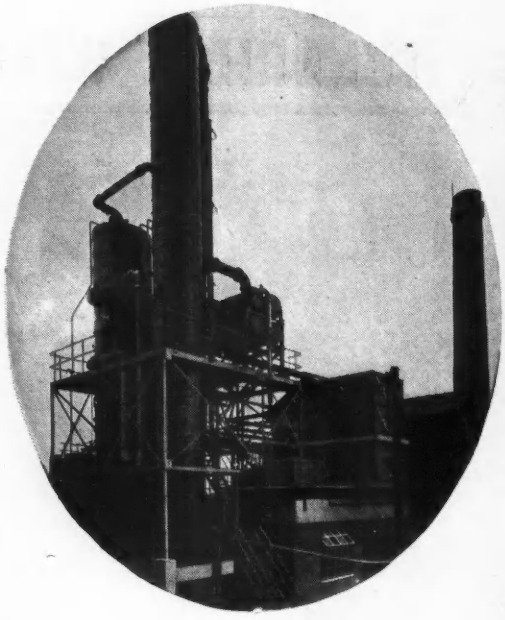

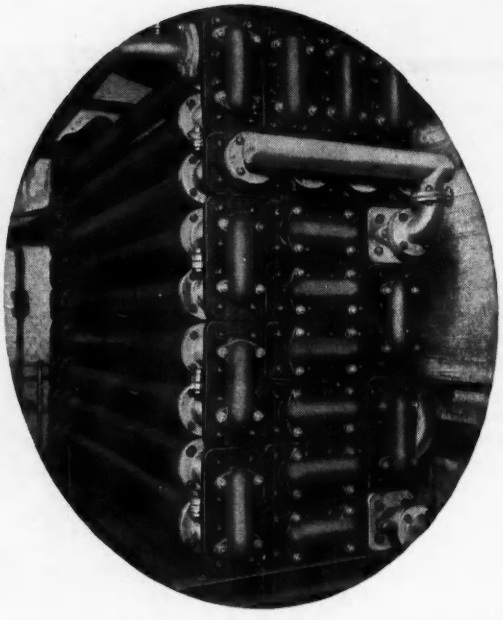

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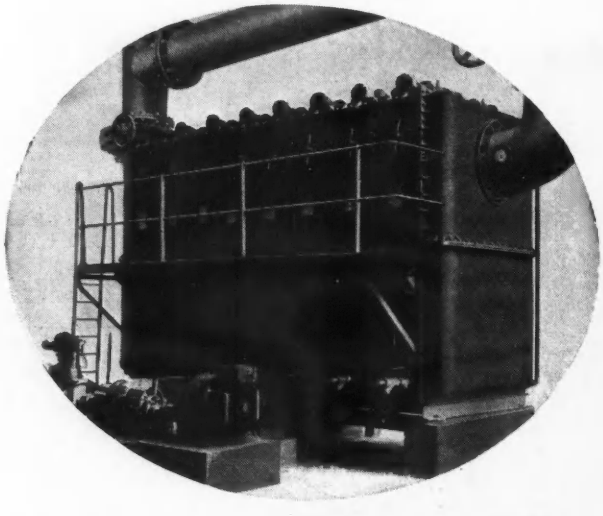

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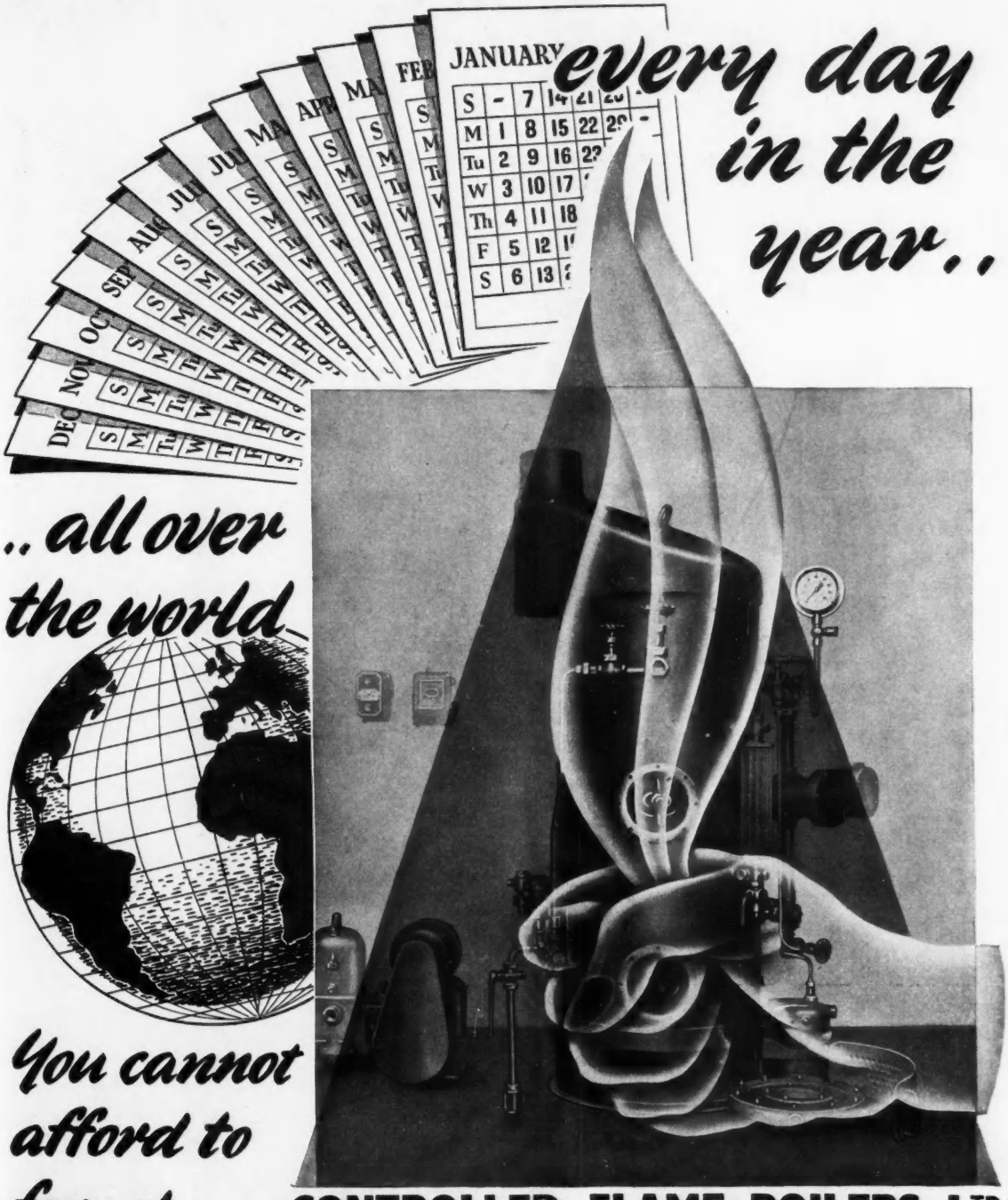

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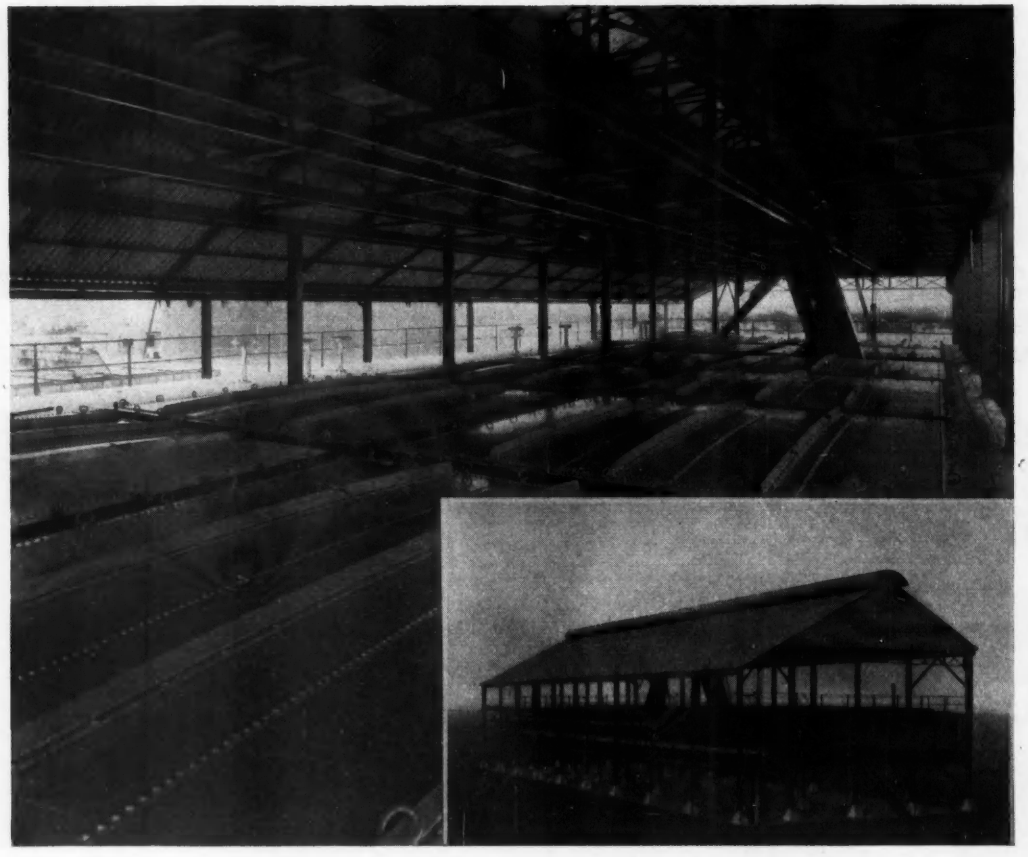

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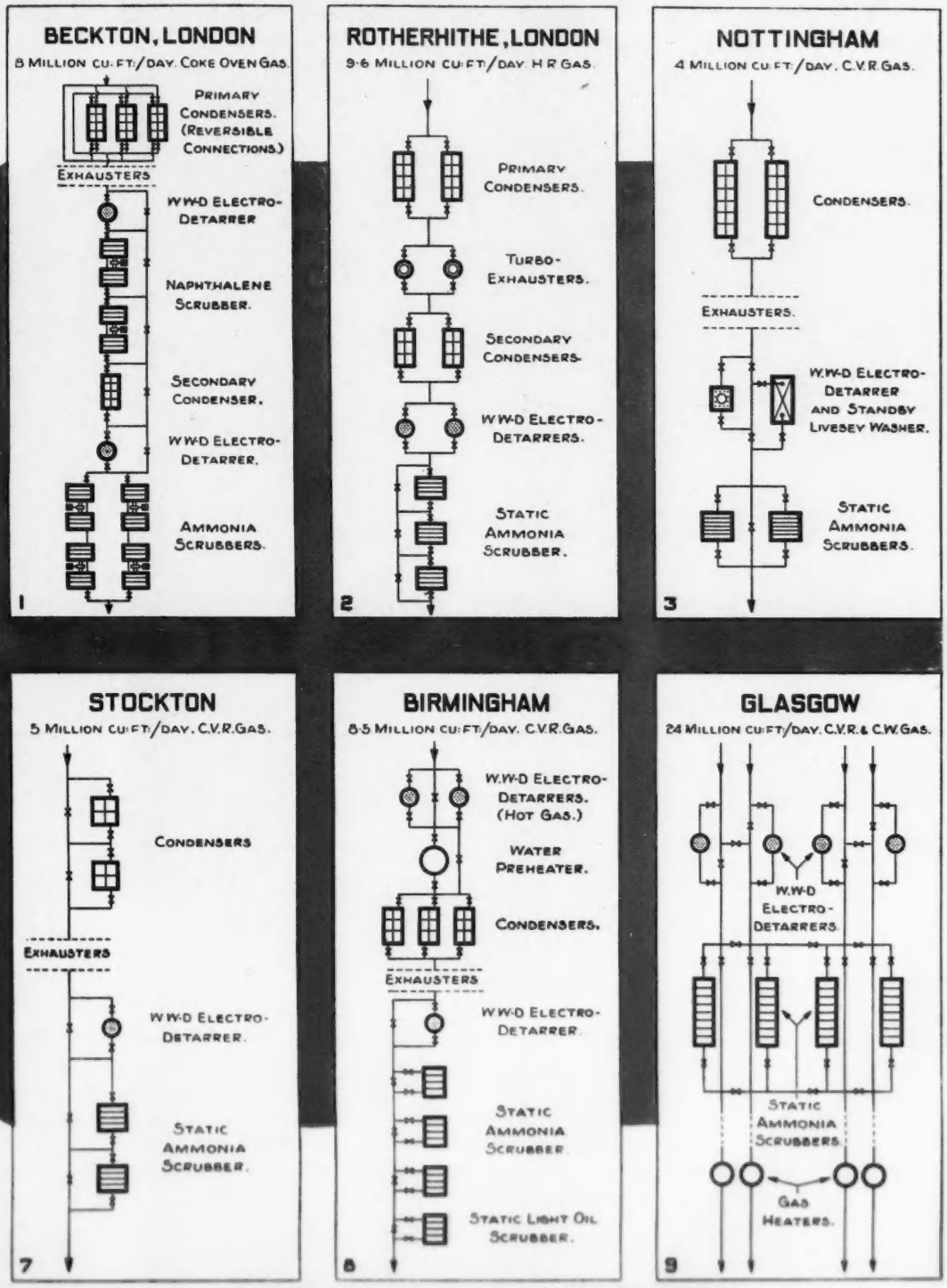

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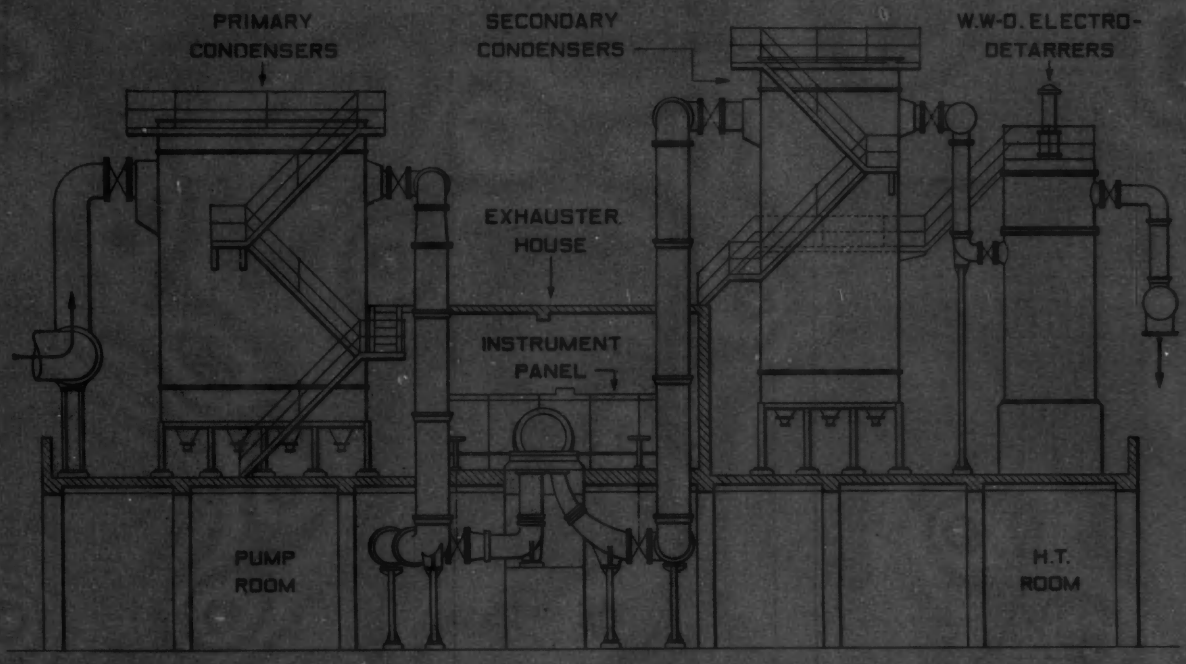
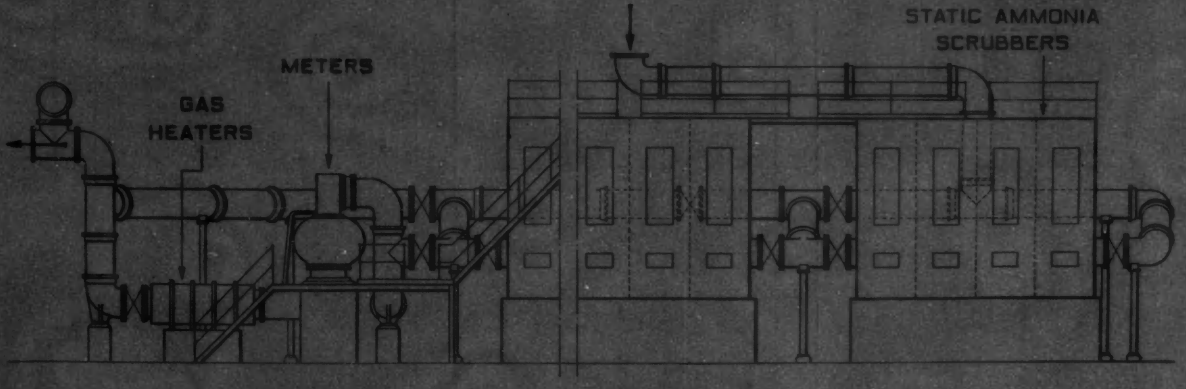


Diagrammatic side elevation of the Whessoe installation South Eastern Gas Board, East Greenwich



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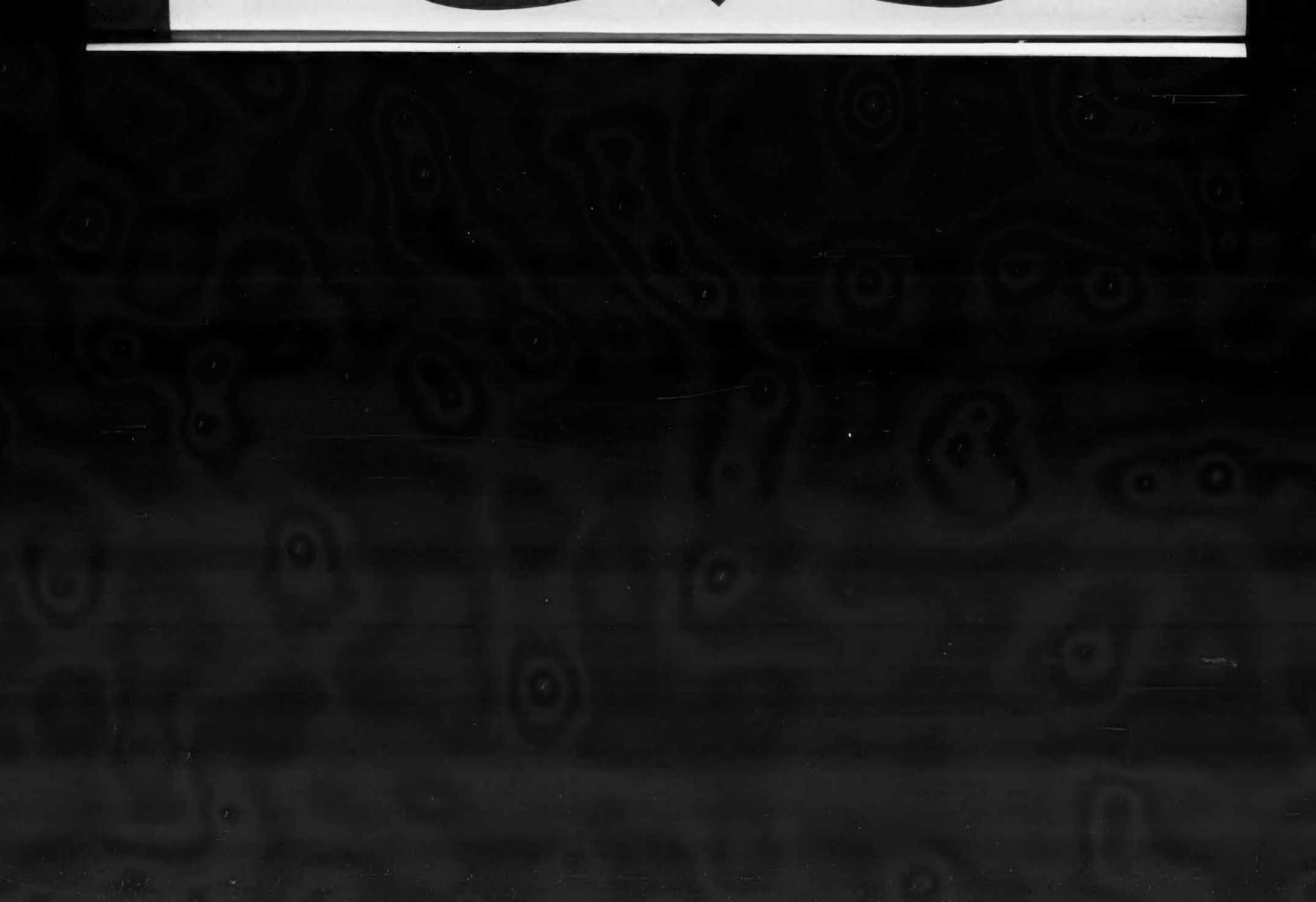

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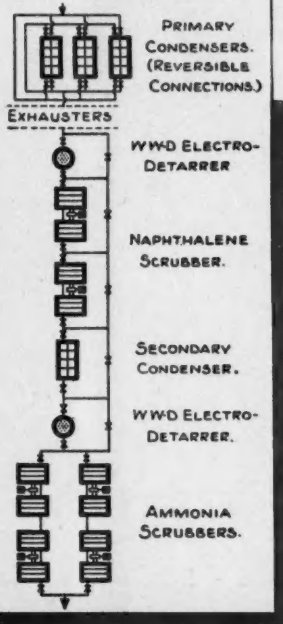

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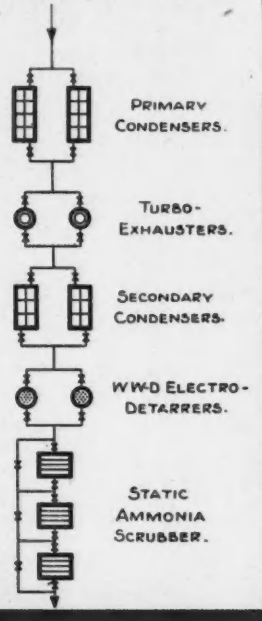

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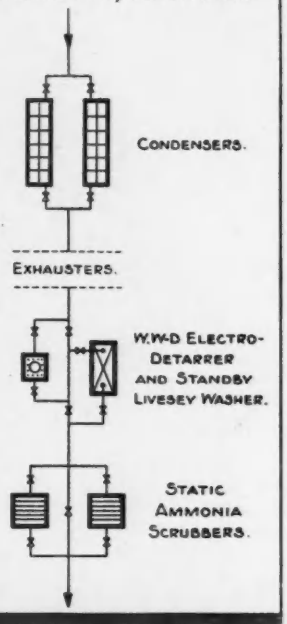
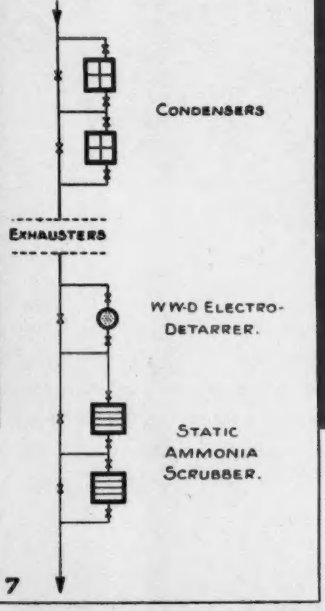


3

STOCKTON

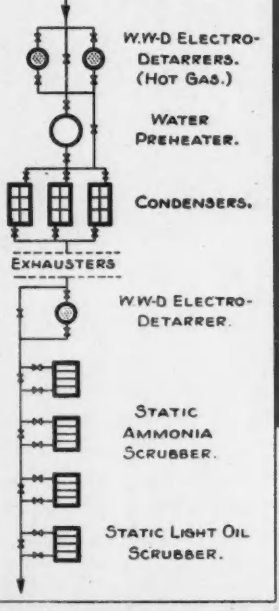
5 MILLION CU. FT./DAY. C.V.R. GAS.



7

BIRMINGHAM

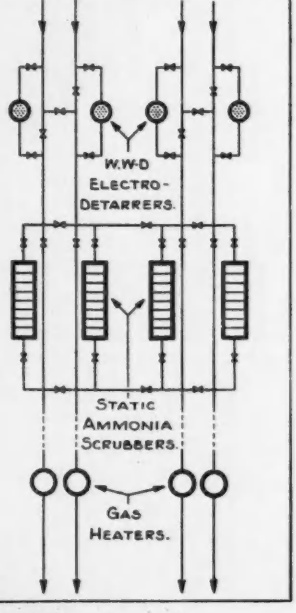
8·5 MILLION CU. FT./DAY. C.V.R. GAS.



8

GLASGOW

24 MILLION CU. FT./DAY. C.V.R. & C.W. GAS.



9

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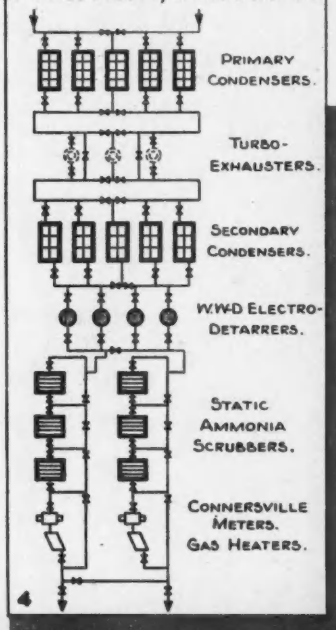
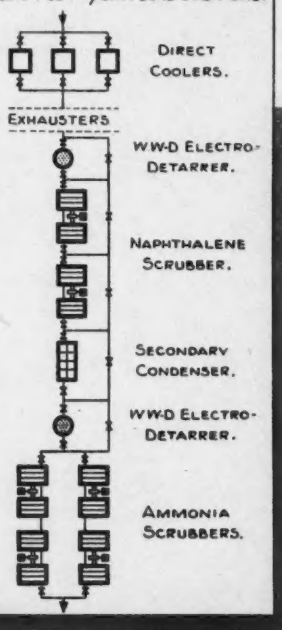
31·4 MILLION CU·FT./DAY. COKE OVEN GAS.



4

BECKTON, LONDON

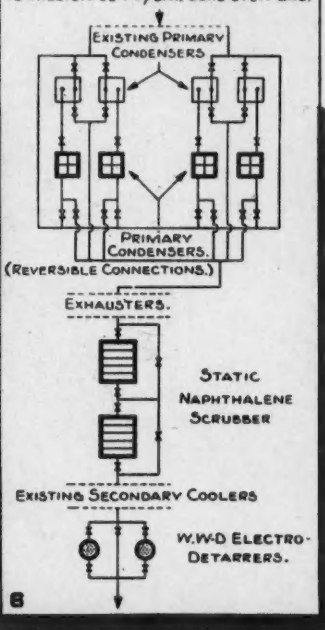
8 MILLION CU·FT./DAY. COKE OVEN GAS.



5

BECKTON, LONDON

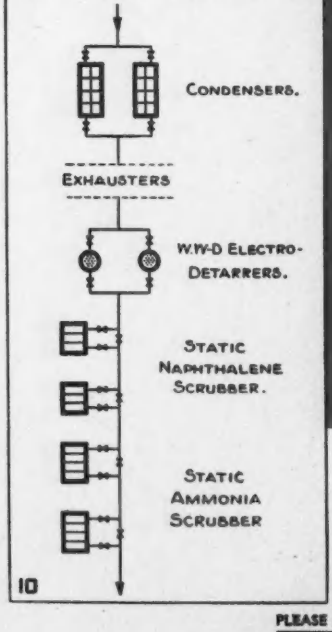
16 MILLION CU·FT./DAY. COKE OVEN GAS.



6

ODENSE

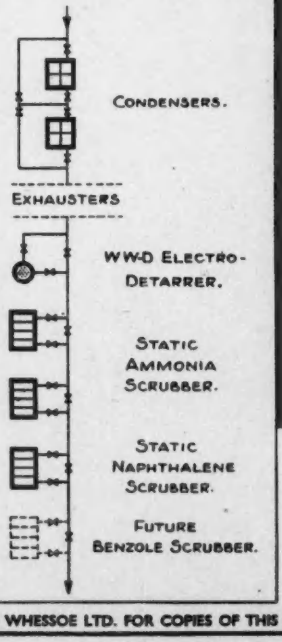
80,000 CU·M/DAY. C.V.R., I.V.C. & C.W. GAS.



10

WREXHAM

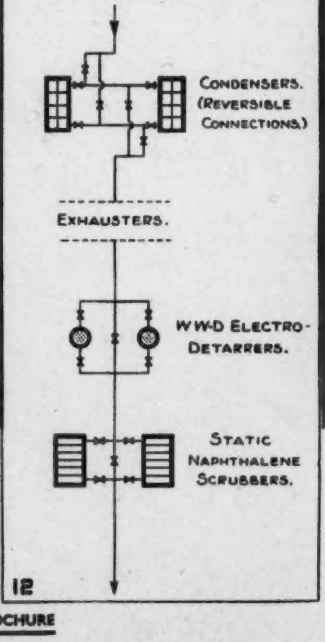
5 MILLION CU·FT./DAY. I.V.C. GAS.



11

SOUTHALL, LONDON

14·5 MILLION CU·FT./DAY C.W. GAS.



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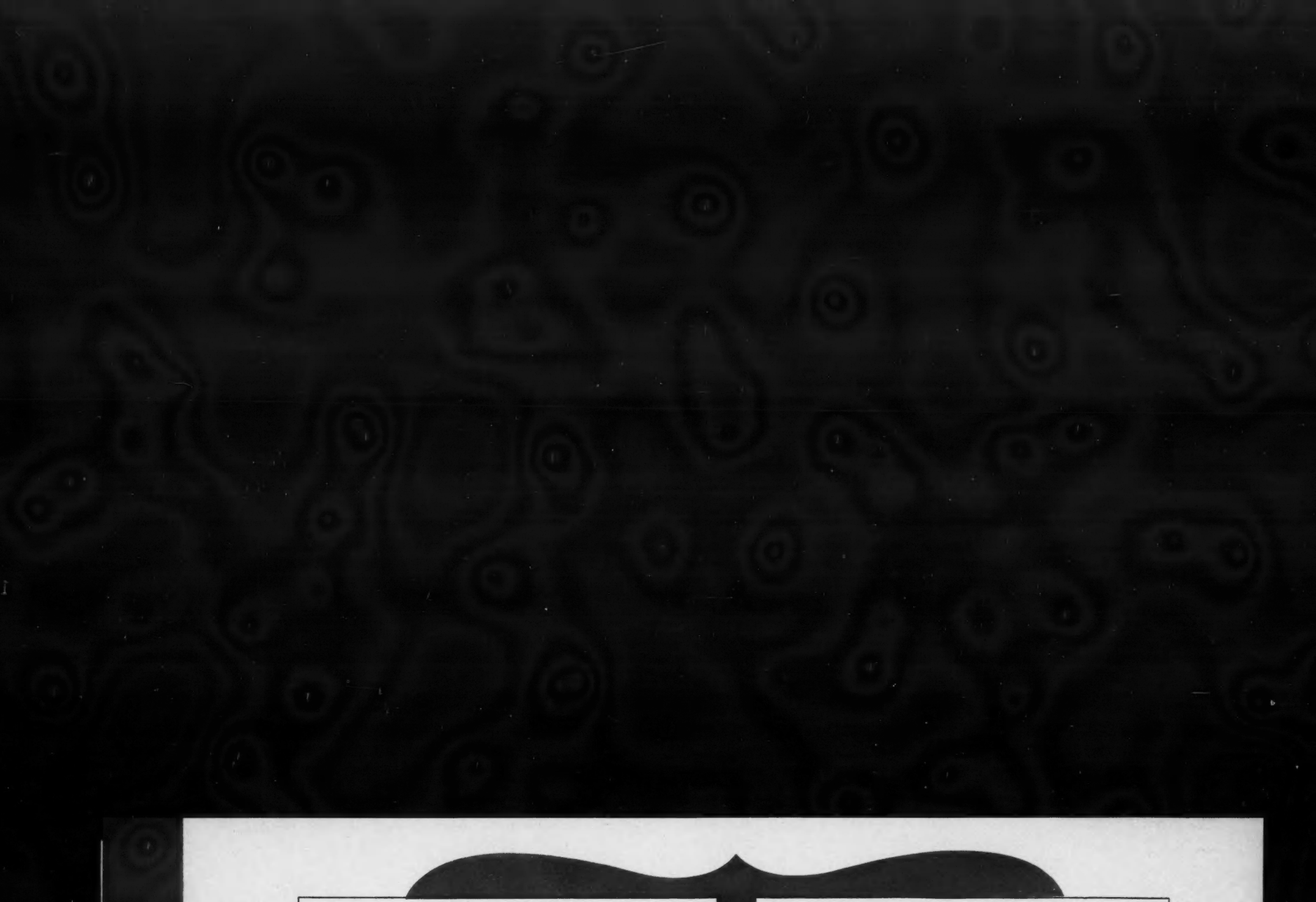

MODERN

Wet Purification Plant

by

WHESSOE

Perspective illustration of a simple wet purification installation of a similar type to that shown in flow diagram 7 within

The flow diagrams on pp. 2 and 3 of this folder, two of which are illustrated on the cover pages, show the variety of unit plants and sequences which may be employed to accord with modern gas works practice, and to achieve the desired gas temperature, pressure and constituent vapour pressures, before entry of the gas to the dry purifiers. The requirements of Gas Undertakings vary according to the carbonising systems employed and the allowable capital expenditure. Individual preferences may be accommodated whilst still conforming with sound general practice. For further information on these important matters, please consult:

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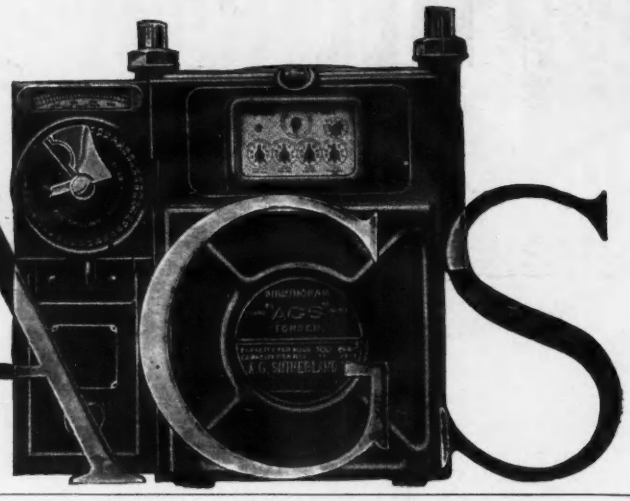

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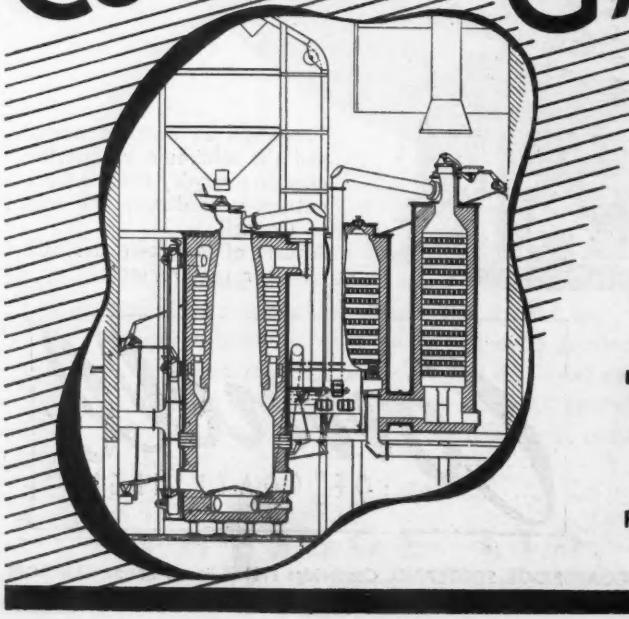

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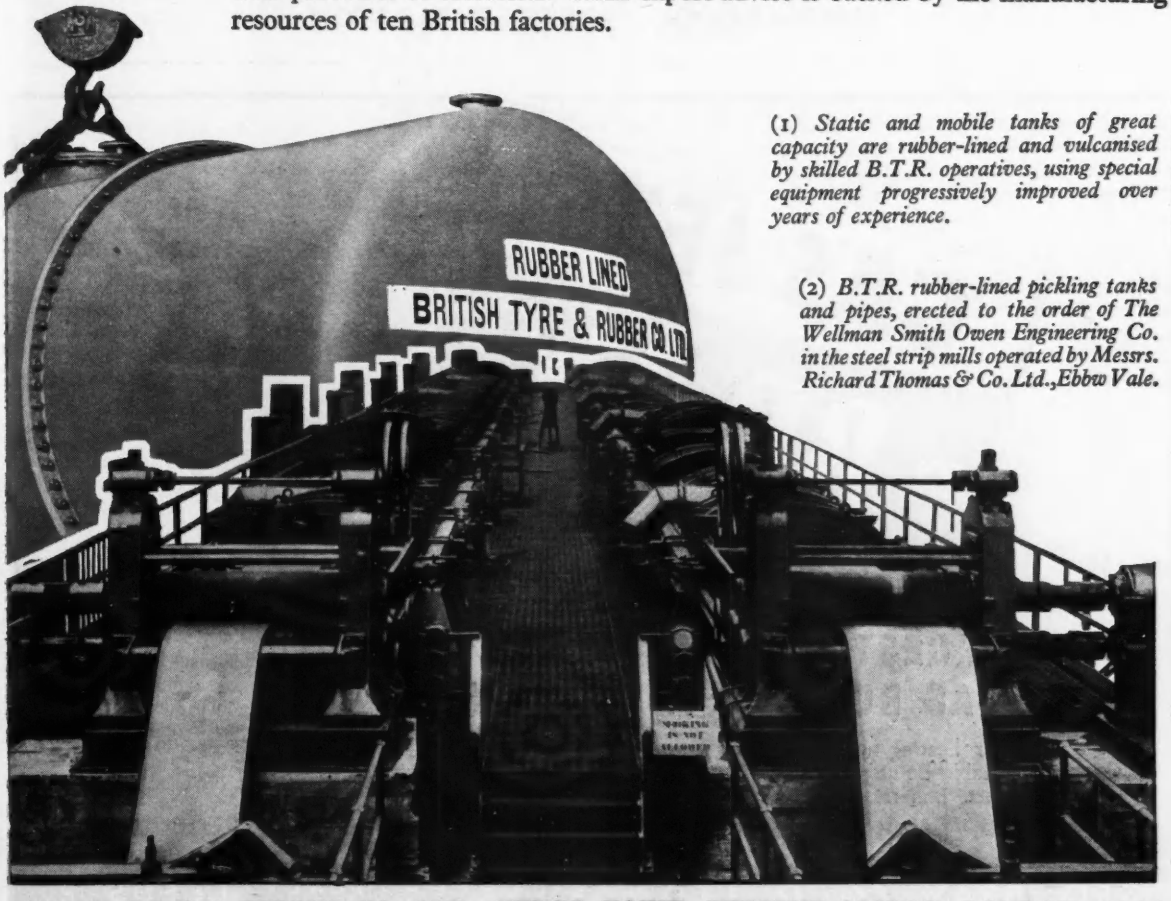

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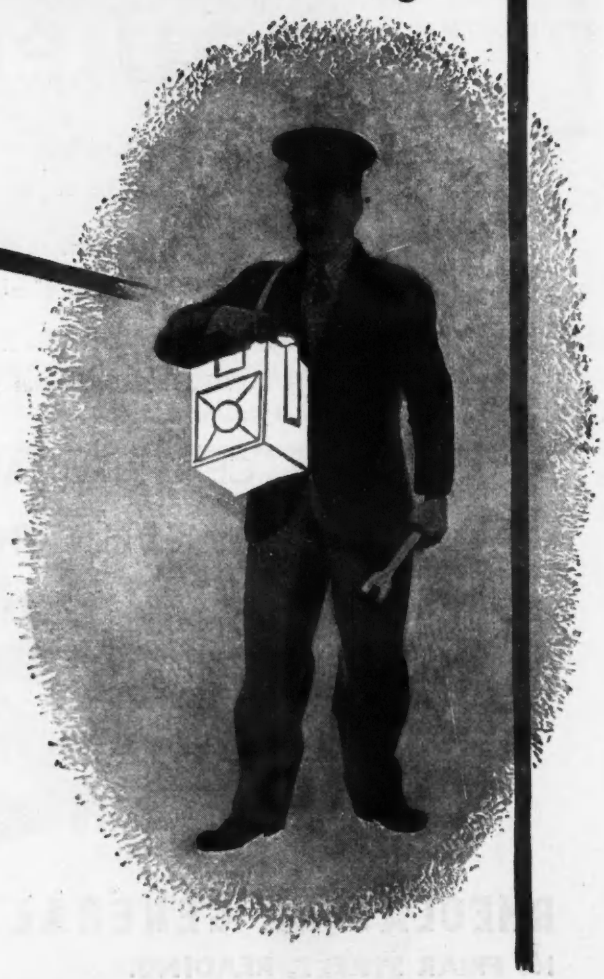

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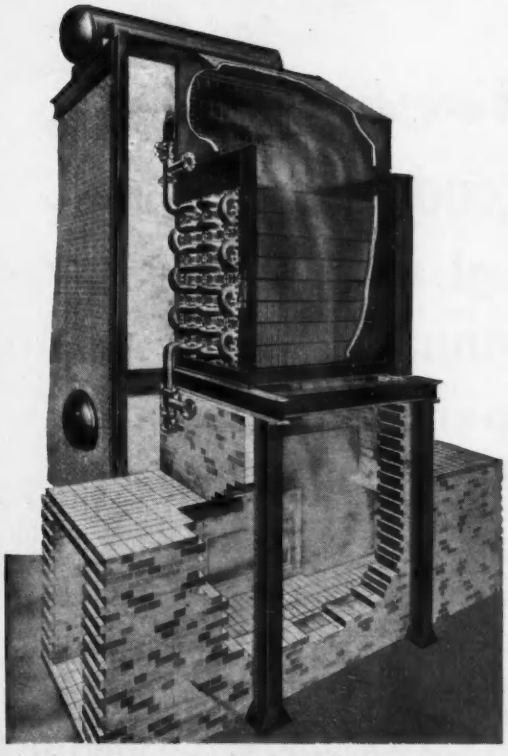

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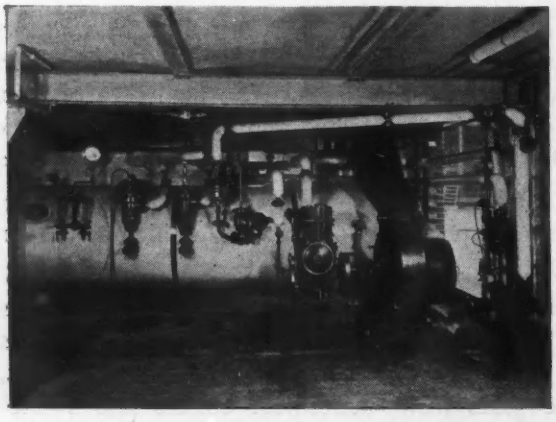

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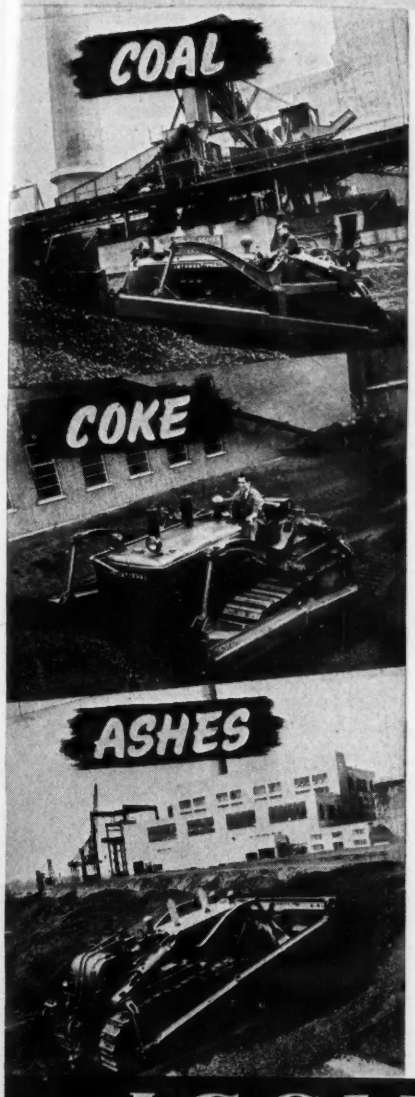

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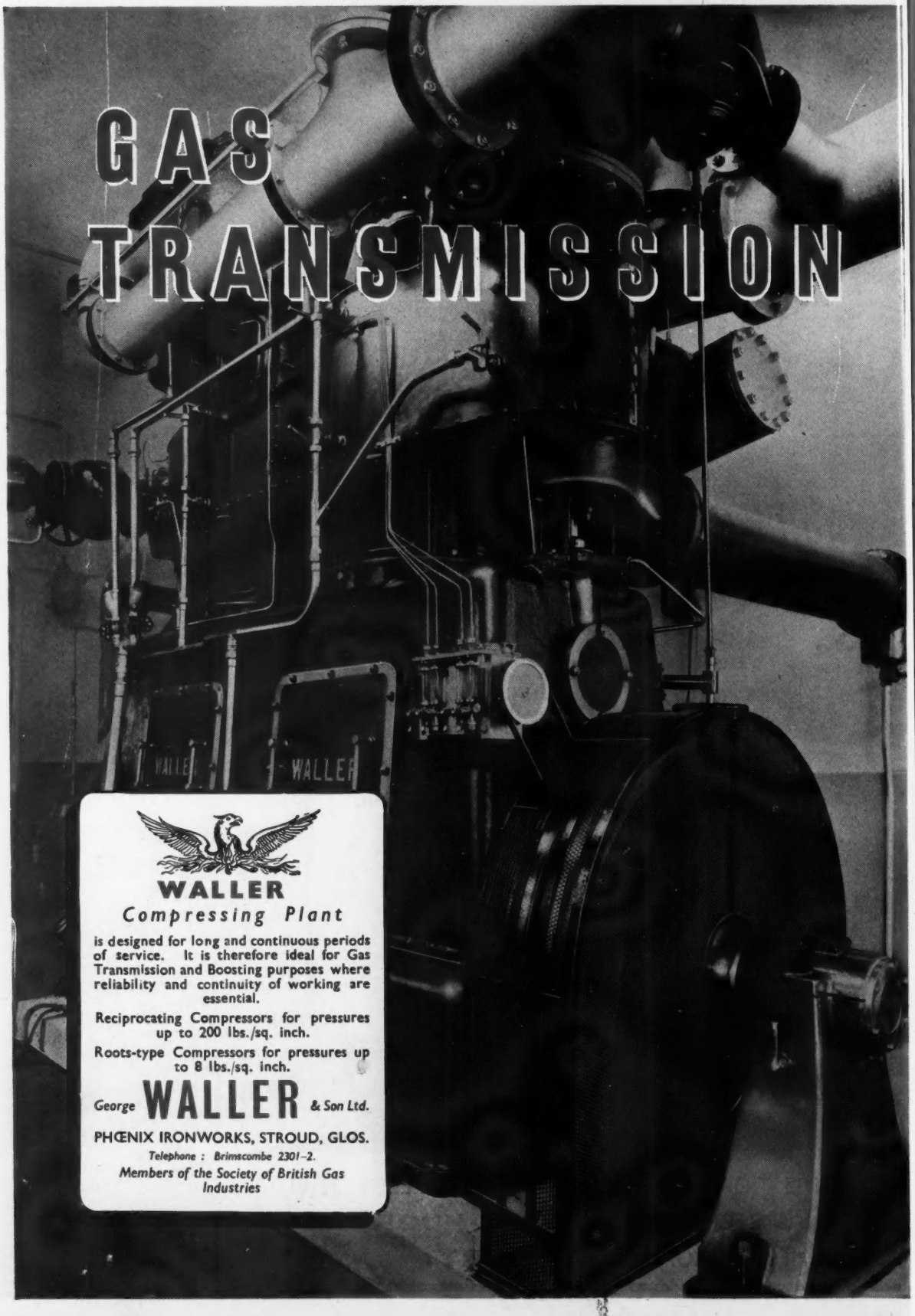

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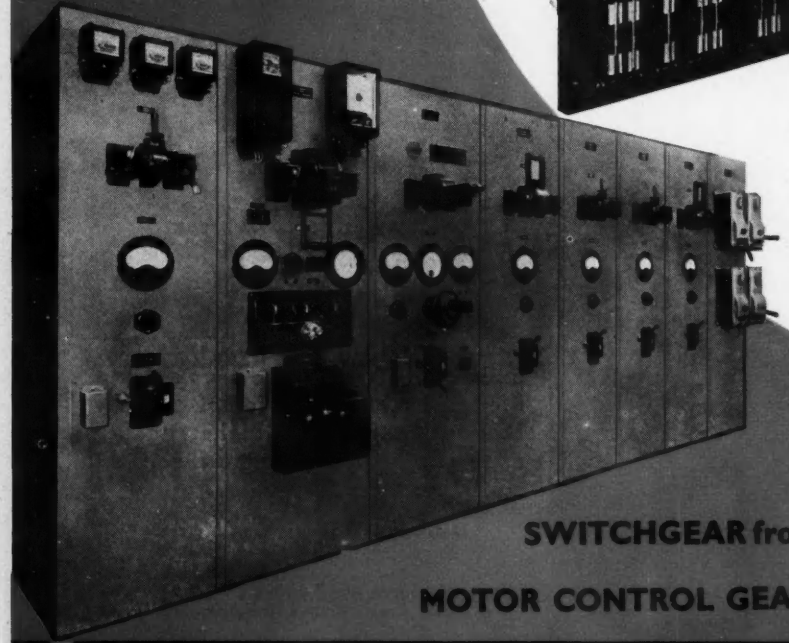

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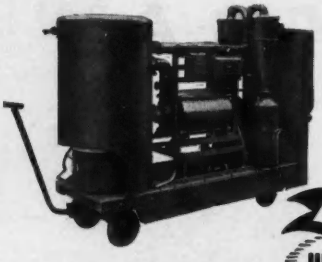

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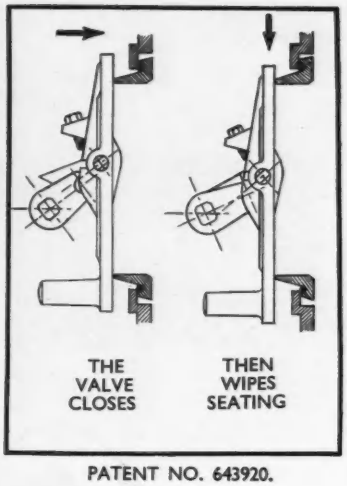

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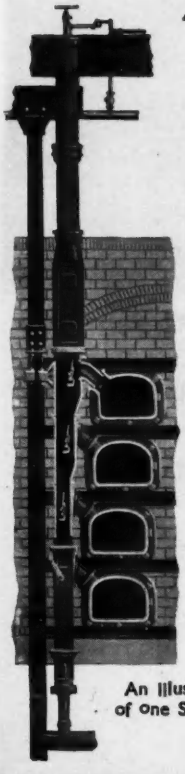
A Photograph of a Congdon Installation



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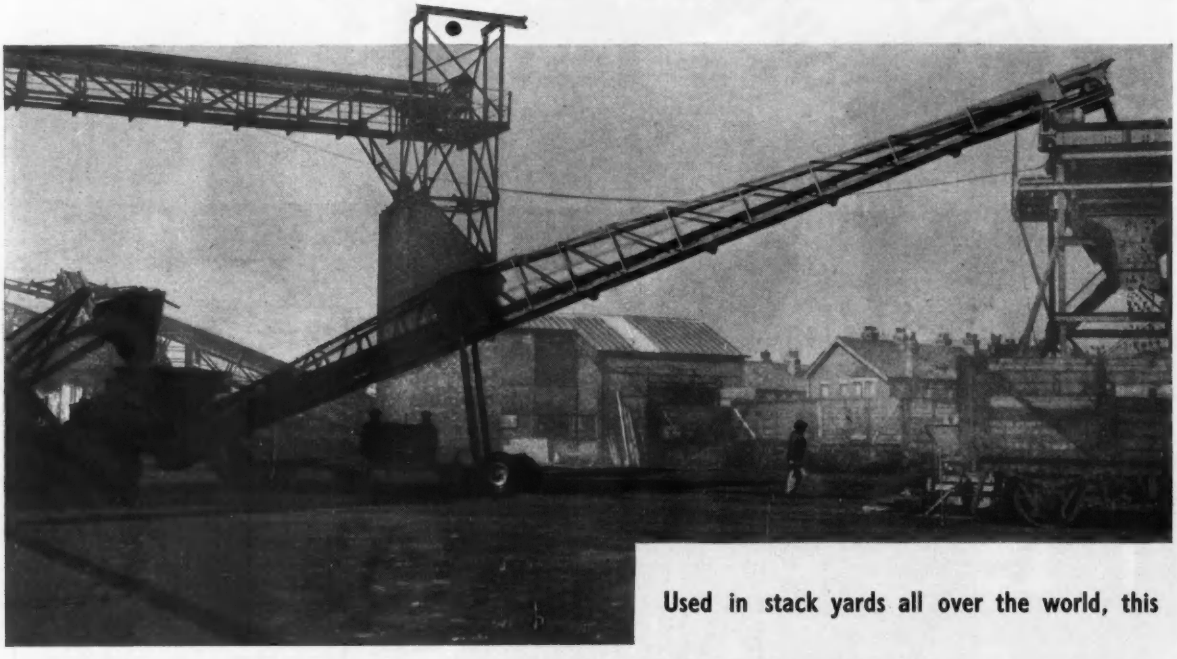

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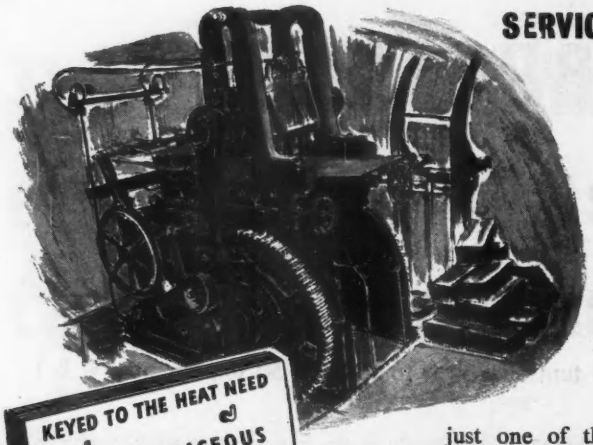
D.S.F. Refractory Reflections: No. 5

SERVICE TAKES SHAPE . . .



Raw materials of uniform high quality having been blended in correct proportion are then shaped for service. The method used depends firstly on the shape required and secondly on the particular brand of product. They may be subjected to pugging and subsequently hand-moulded or pressed, or directly shaped by powerful modern presses. To ensure uniformity of size and density, weights are strictly controlled.

The plants for the manufacture of "PEAKSIL" brand and "DOME" brand products are each separate and distinct units from those producing the Siliceous, Fireclay and Aluminous refractory materials. This is just one of the many precautions taken to ensure that every brand is true to its strict formula and therefore keyed to specific needs, ensuring a long life of high service.

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SILICA, SILICEOUS
FIRECLAY, SILLIMANITE
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'DOME' INSULATION
Products satisfy the most exacting demands of modern carbonising conditions.
'D.S.F.' MATERIALS
used for vertical and horizontal systems.

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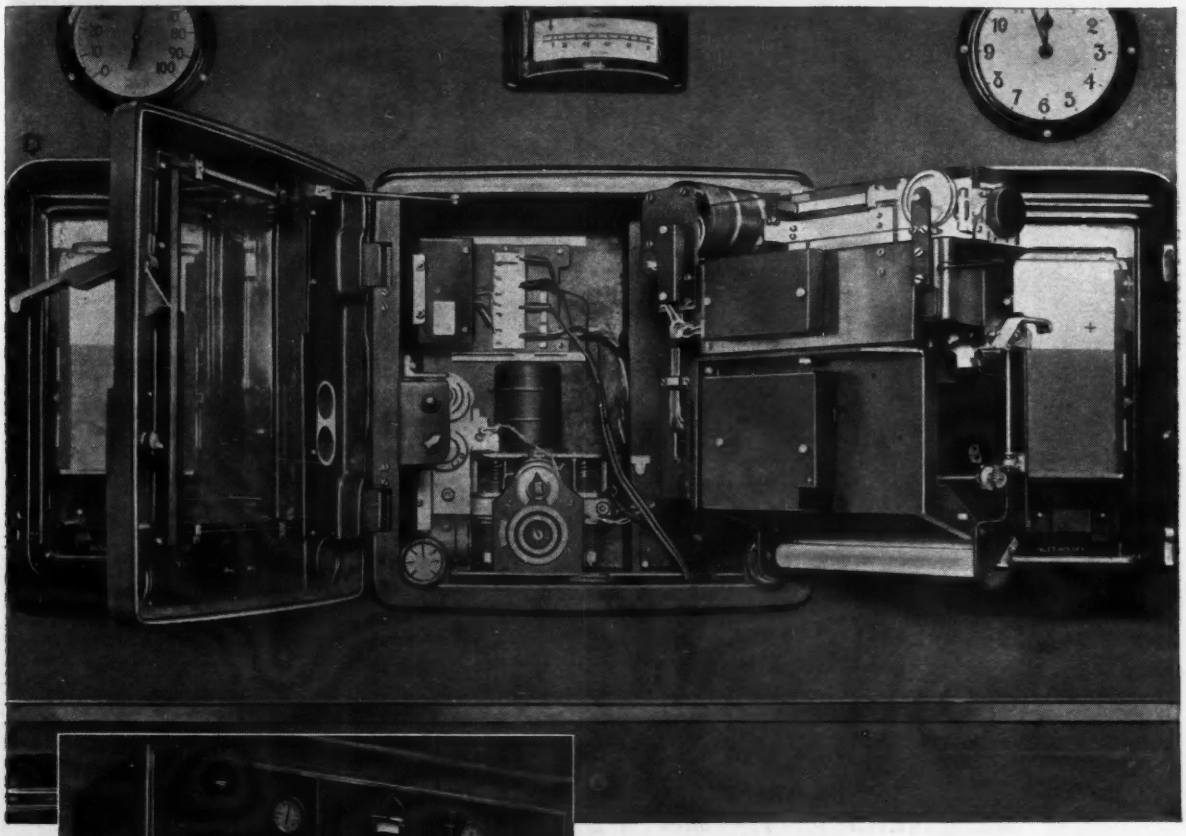
ESTABLISHED OVER HALF A CENTURY

Elliottronic

RECORDER-CONTROLLER FOR AUTOMATIC C.V. CONTROL



The admission of diluent gas to retort gas may be automatically controlled by the Elliottronic Recorder and Elliottrol Trimode Controller, enabling calorific value to be maintained to within close limits under supervisory control only.

The technique employed depends upon the layout of the gas manufacturing plant and, where appropriate, may include flow ratio control.

Proposals for automatic C.V. control equipment will be submitted free on request.

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THE STAVELEY IRON & CHEMICAL CO. LTD., NR. CHESTERFIELD

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one of our Apprentice Moulders who we introduced to you in earlier issues. Mitchell is making excellent progress both in the Foundry and with his studies so that he may be able later to assist in the making of high grade castings for which we have been renown for many generations.

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We shall be glad to consult with you as to the type and layout of purification plant best fitted to meet your needs.

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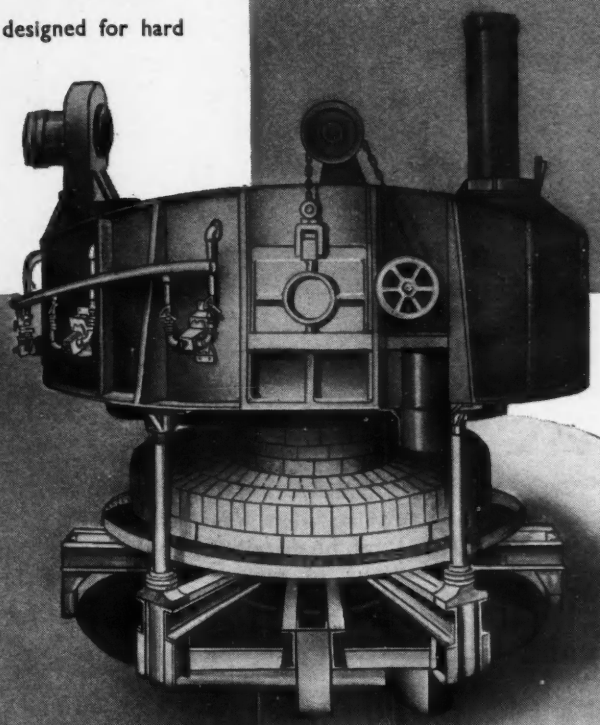
These furnaces are designed for hard usage, critical temperature control, and practically scale free heating.



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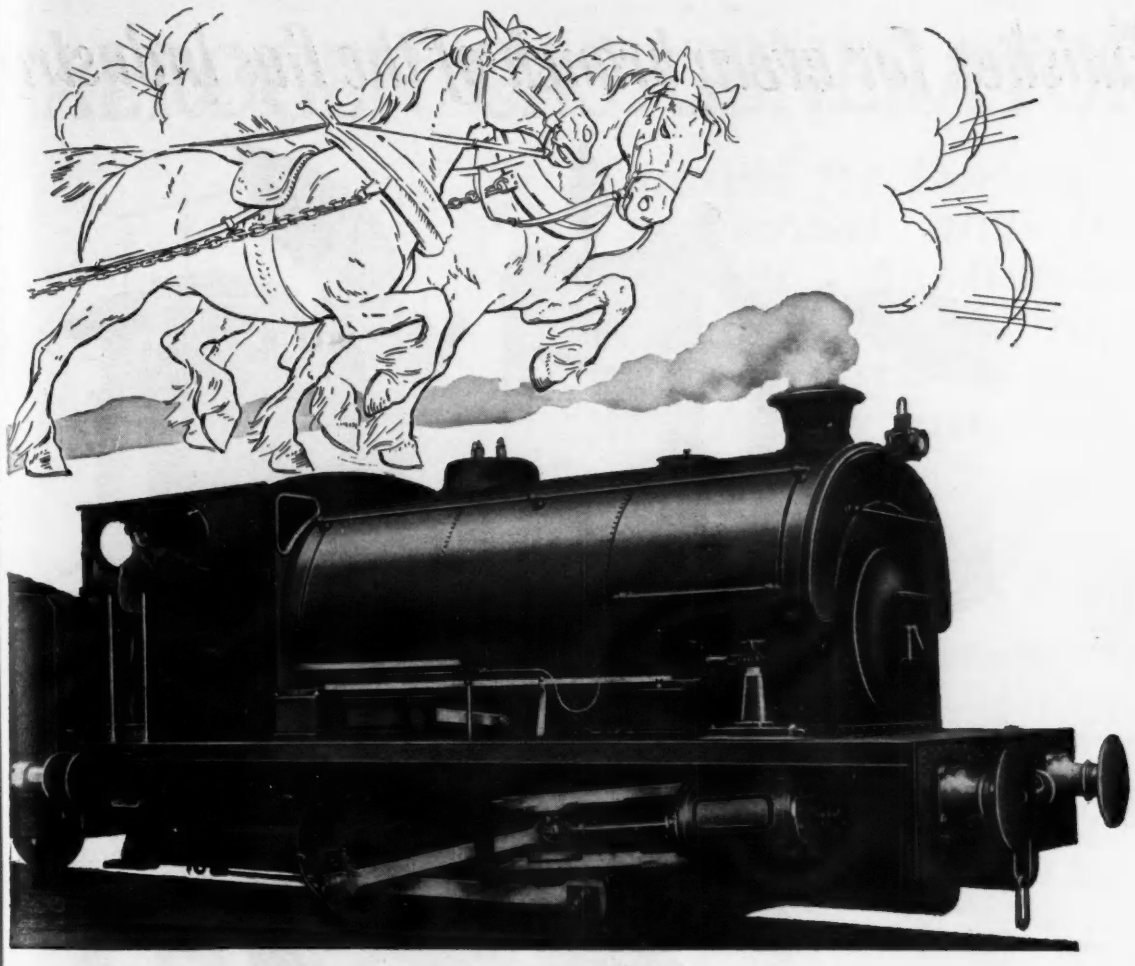

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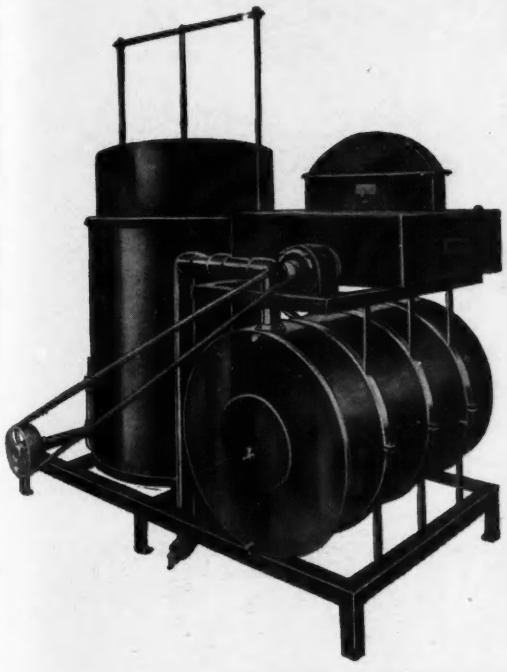

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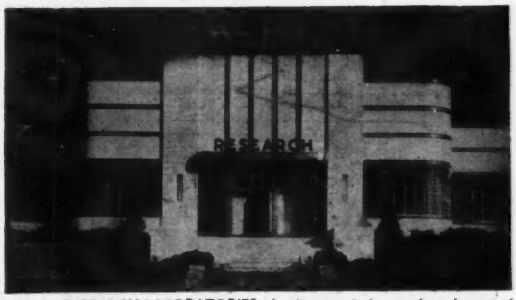

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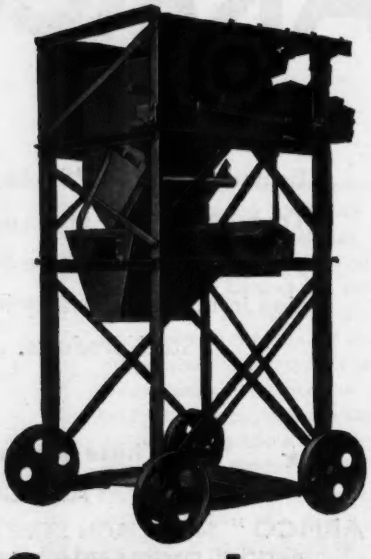
THE SIMON PATENT AUTOMATIC COKE WEIGHER

Approved by the Board of Trade and stamped by the Weights and Measures Authorities.



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Guaranteed accuracy and continuity of operation.

Machines may be seen working by appointment.

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for gas service, carcassing and installation pipelines

Non-ferrous pipelines assembled with "Yorkshire" Capillary Fittings are neat in appearance, permanently reliable, simple and quick to instal and show a definite saving in materials and labour costs; the smooth, full bores ensure an unrestricted flow of gas to the appliances.

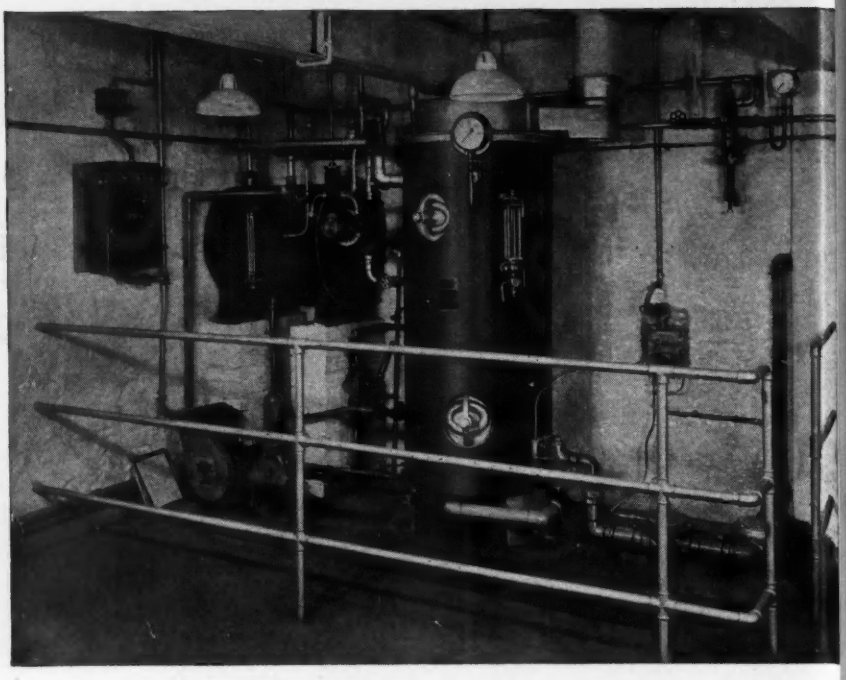
"Yorkshire" Fittings are hot pressed from brass and are therefore non-porous, whilst the joints are proof against seepage and unaffected by expansion, contraction or vibration.

They are made in a wide range of types and sizes to cover all requirements for service, carcassing and installation pipelines. They are suitable for use underground as they are made from hot pressings in an alloy which ensures that the fittings are highly resistant to dezincification.

Above Installation Photograph by courtesy of The Eastern Gas Board, Tottenham Division.

The YORKSHIRE COPPER WORKS LIMITED LEEDS

AND BARRHEAD, SCOTLAND



The illustration shows a Brockhouse VS series gas fired boiler complete with fully automatic condensate return system, incorporating control panel, feed pump, condensate receiver, boiler feed regulator, etc. Installed for use with bottle washing plant.

Compact gas fired steam boiler units of high thermal efficiency — PRESSURE UP TO 100 lbs. per sq. in.

Brockhouse Gas-fired Steam Boilers have all steel bodies with riveted side and end plates to ensure long life. Boilers are available in a range of sizes from 30-400 lbs. of steam per hr. Installation is simple as boilers can be connected to existing gas and water supplies. The Brockhouse Automatic Condensate Return System can be supplied complete with drawing, wiring diagram and fixing instructions, ready for connection to steam condensate mains to give fully automatic control combined with economy and efficiency. Alternative water feed arrangements are available to suit any conditions.

Full details and schemes on request from our Technical Advisory Service Department.

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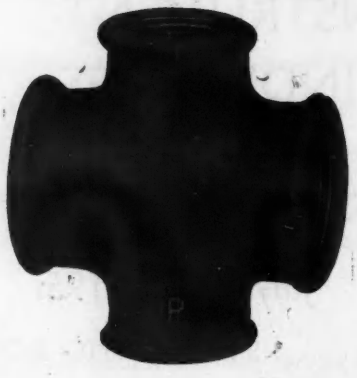

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Sizes ⅛ to 6 ins.

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This morning I was asked by the management " What are our probable requirements for cookers during the next six months?" Ten minutes afterwards, they wanted to know how many H.P. agreements were in arrears. I can remember the time when it would have taken me a couple of days to look out the answers. Now with Roneodex I can give it to them in an hour or so. I'm glad the committee decided to install this system — it's worth its weight in gold.

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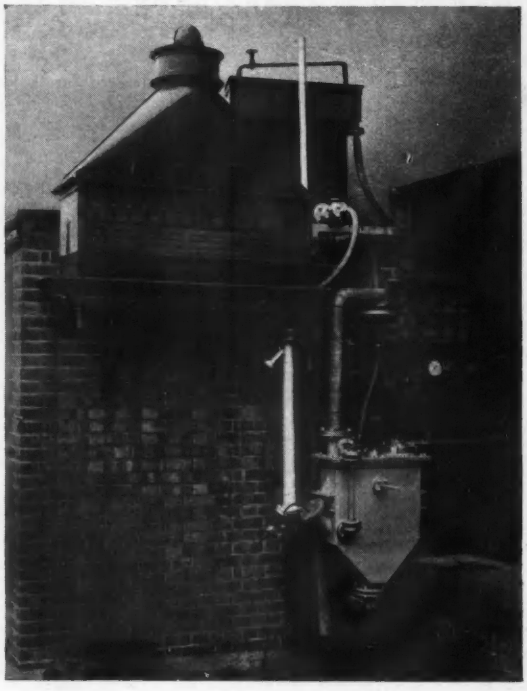

SPENT PICKLE RECOVERY PLANT

Illustration shows a Pilot Plant for evaporation of spent pickle from strip mills for the continuous recovery of free acid and monosulphate of iron by use of Swindin Patent Submerged Burner and Patent Pre-evaporator. Factor of performance 1·3. Can be seen in operation any time on application to :—

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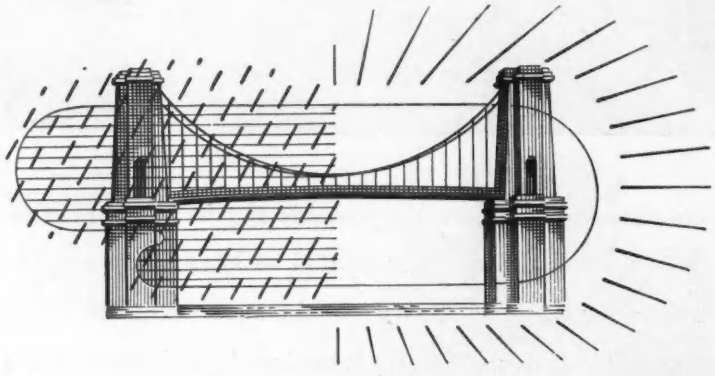

IN JUNE ooo or JANUARY

The one topic of conversation that never fails in England is the weather. Our life is so dominated by preparation against rain or shine, in season or out, that "protection against weather" holds a special significance.
That is where AVARC SILICA-GRAPHITE paint comes into the picture. Applied to outdoor surfaces, it dries as a tough, leathery skin with sufficient elasticity to expand and contract without cracking under varying temperatures. Iron and steel work are completely protected from corrosion and rust. Today and every day — AVARC SILICA-GRAPHITE paint is protection at its best.

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AVARC Silica-Graphite PAINT
The cheapest paint per year of service
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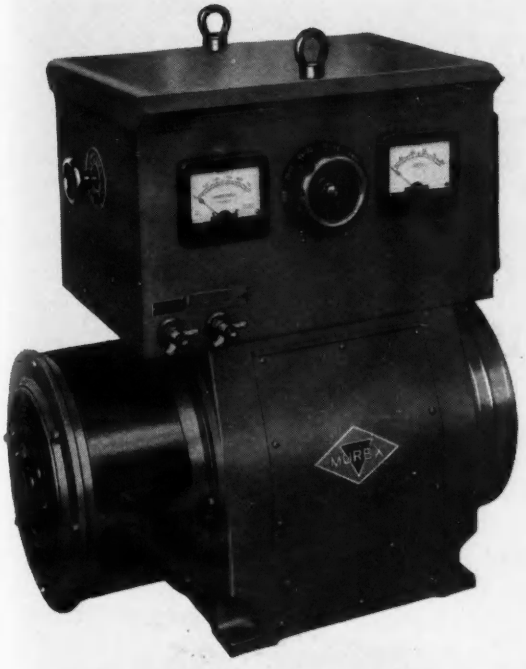

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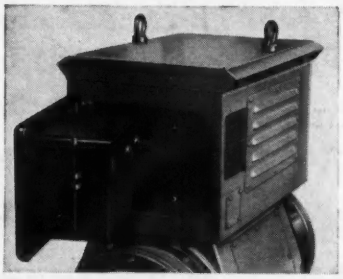
200/300 AMP MOTOR GENERATOR ARC WELDING EQUIPMENT

Built along similar lines to the well-known Murex 300/400 amp motor generator set, this new Murex equipment has been introduced to meet the demand for a motor generator set of lower maximum output. It has a capacity of 20-200 amps for continuous hand welding and up to 300 amps for intermittent hand welding. The generator is of the special Murex patent drooping characteristic type specially designed for electric arc welding and is built into a single carcase with the motor. The set can be supplied for connection to any standard A.C. 3-phase or D.C. electrical supply. Please write for full details.



The above illustration shows the all enclosed, push button operated, oil immersed star-delta starter. This is mounted on a flush door in the control cabinet and is particularly neat in design.

MUREX

ELECTRIC ARC WELDING EQUIPMENT & ELECTRODES

MUREX WELDING PROCESSES LTD., WALTHAM CROSS, HERTS.
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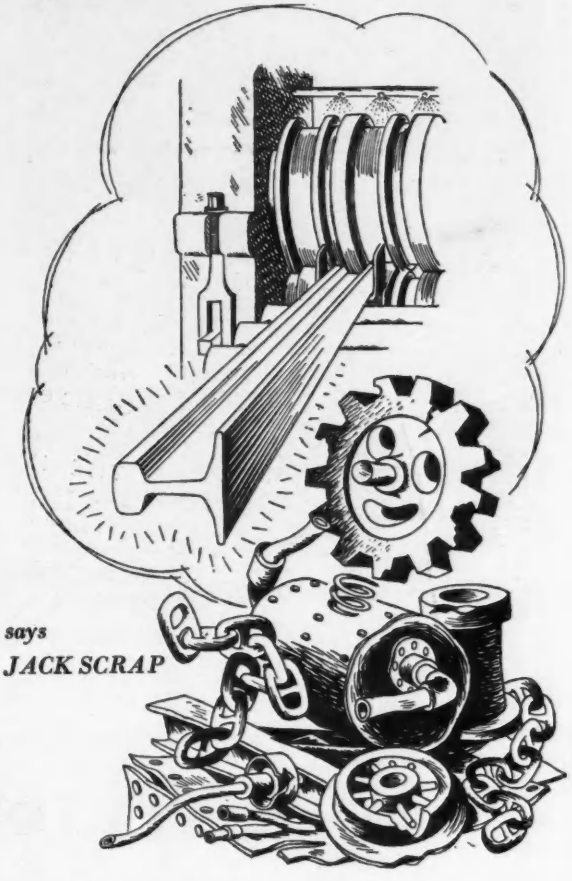

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WANTED
from the
GAS INDUSTRY
Castings, valves and tubes and *every kind* of general and process scrap and obsolete plant.

SPEED THE SCRAP
SPEED THE STEEL

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De-Scaling, Cleaning and Painting of Structural Steelwork and Industrial Plants, Flame De-Scaling etc.

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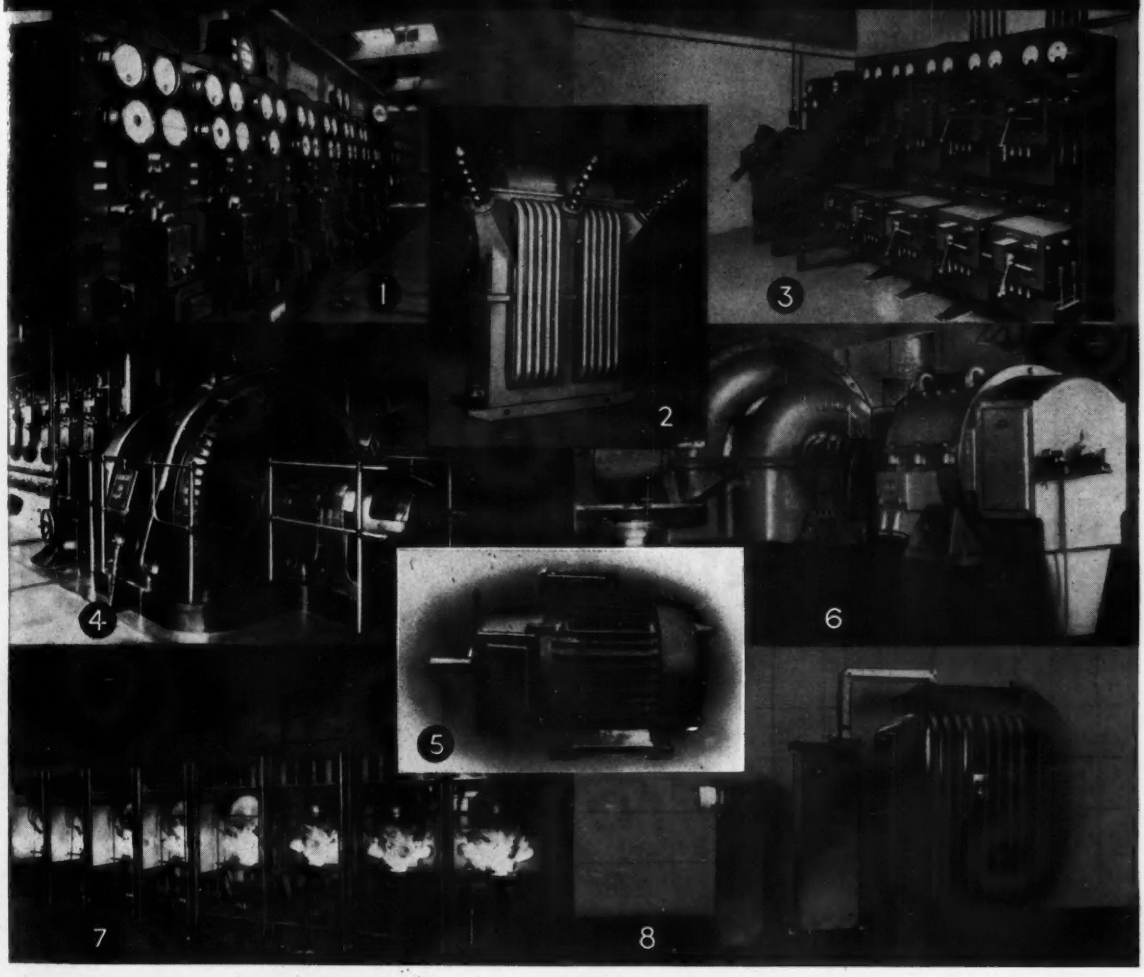

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4. A large H.T. alternator with D.C. exciter (part of a diesel-engine set).
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For A.C.
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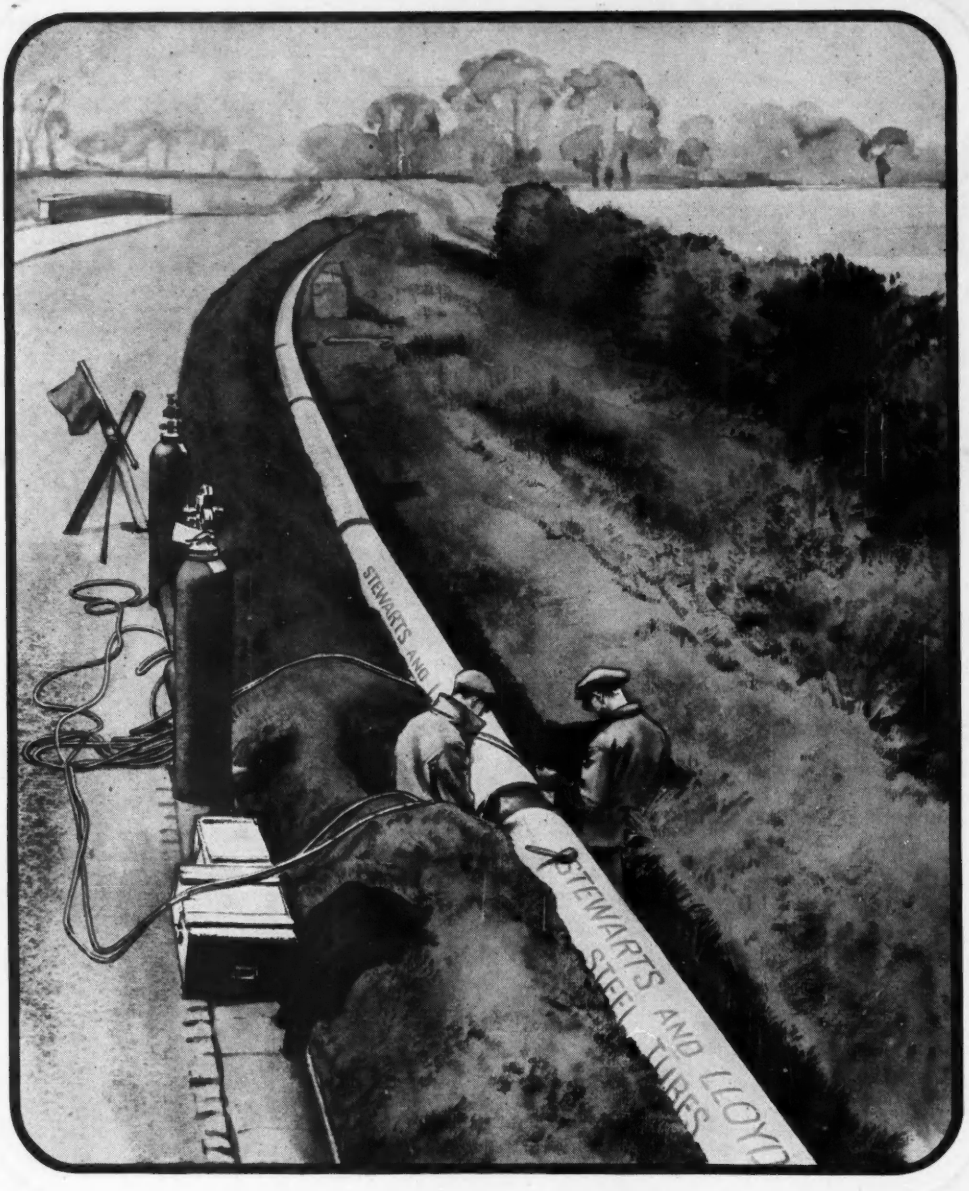

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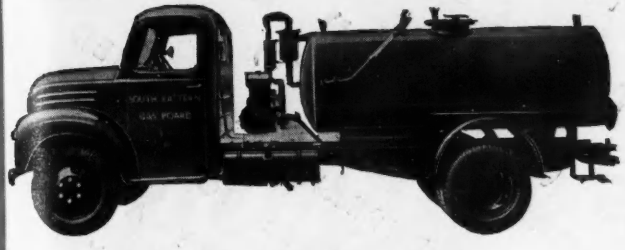

SYPHON EMPTYING OUTFIT

The vacuum syphon emptying outfit illustrated is mounted on a 4-ton Fordson chassis. A 600 gallon galvanised tank is fitted. A rotary type exhauster is driven by a 2½ h.p. four-stroke hopper cooled engine, mounted on a sub-frame behind the cab. The tank is fitted with a flame-proof vent and the outfit can be used for high or low pressure syphon emptying. A large manhole at the rear allows the tank to be cleaned easily.

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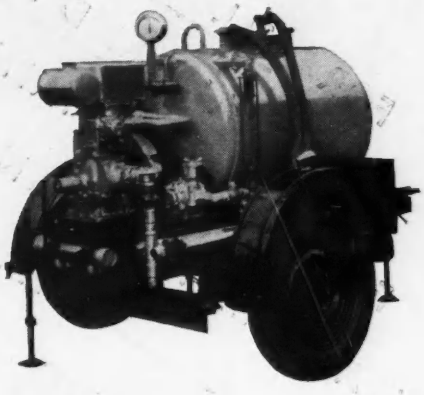

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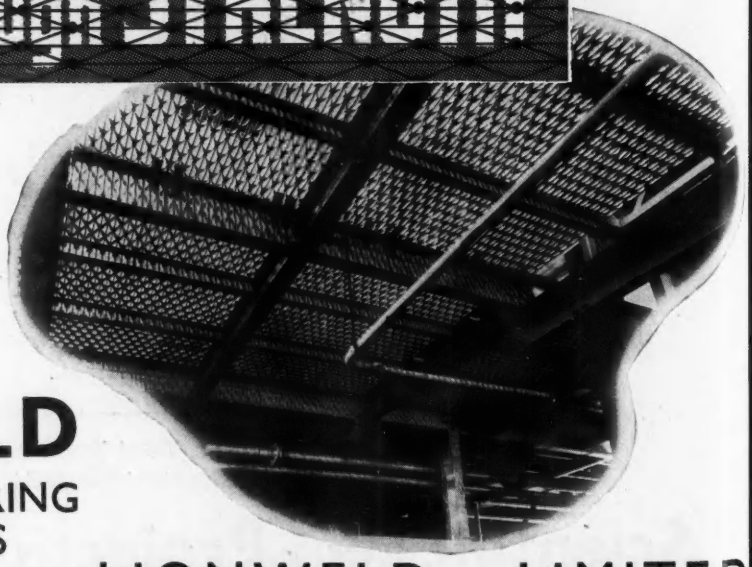

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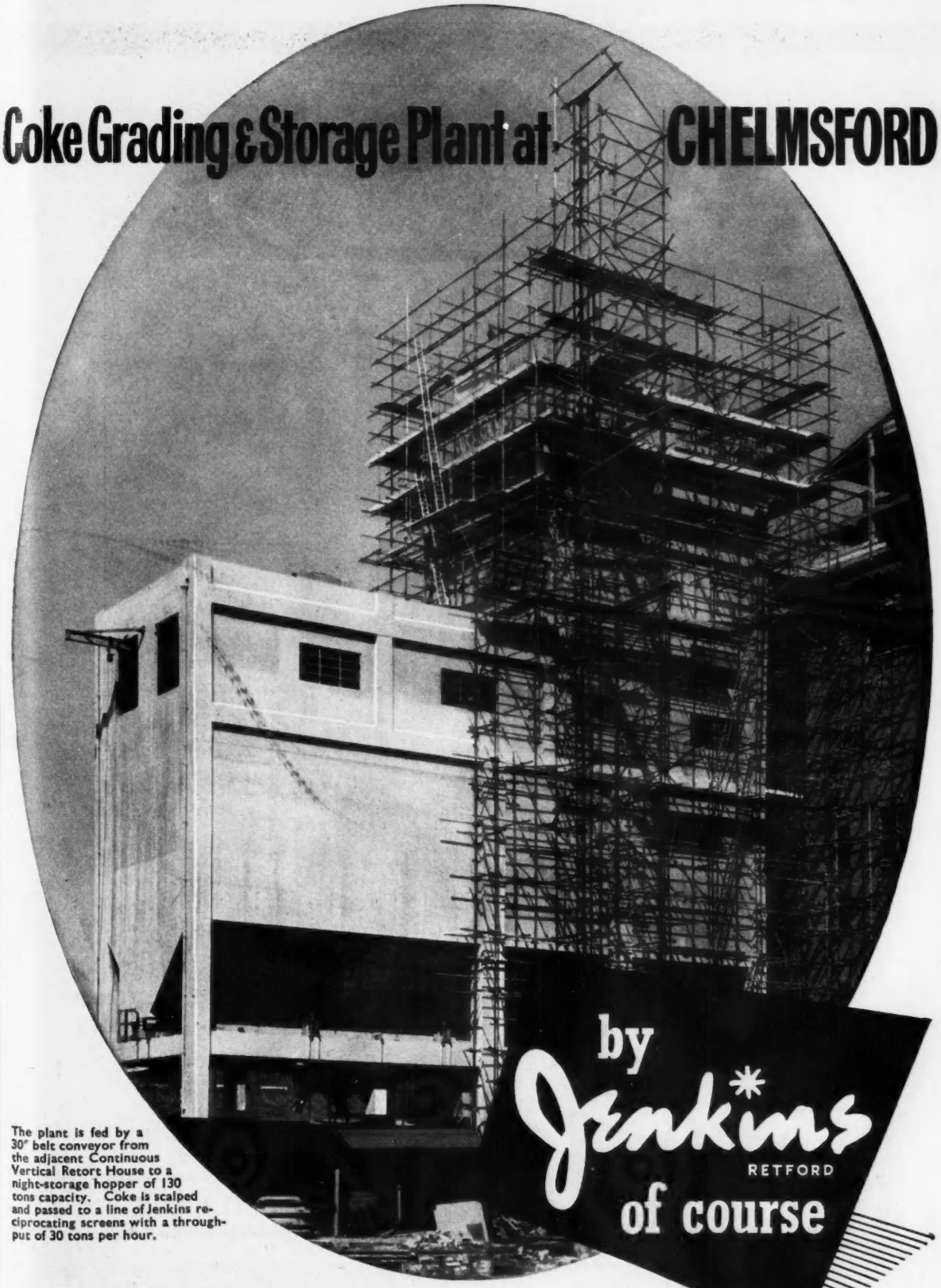

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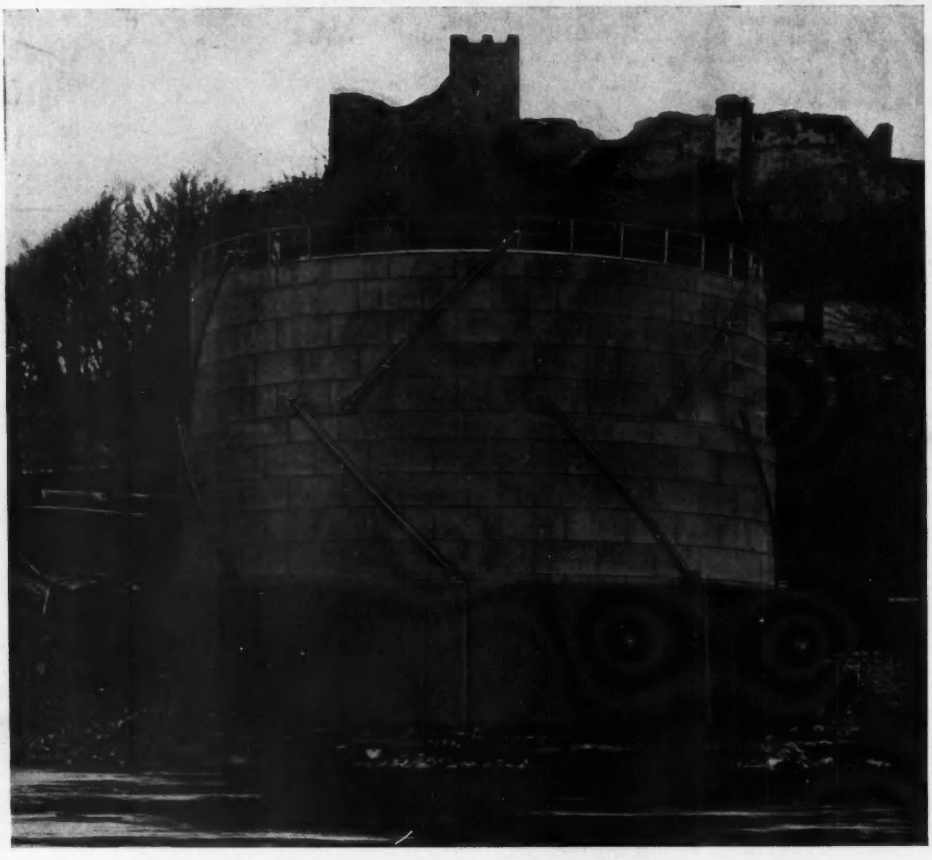

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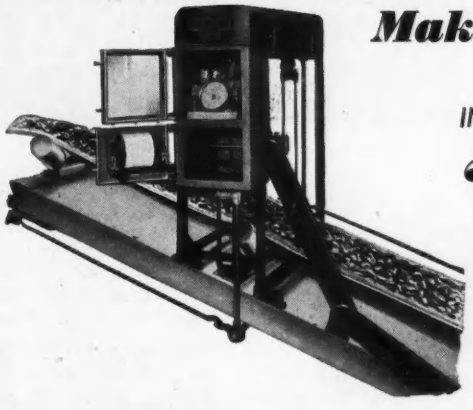

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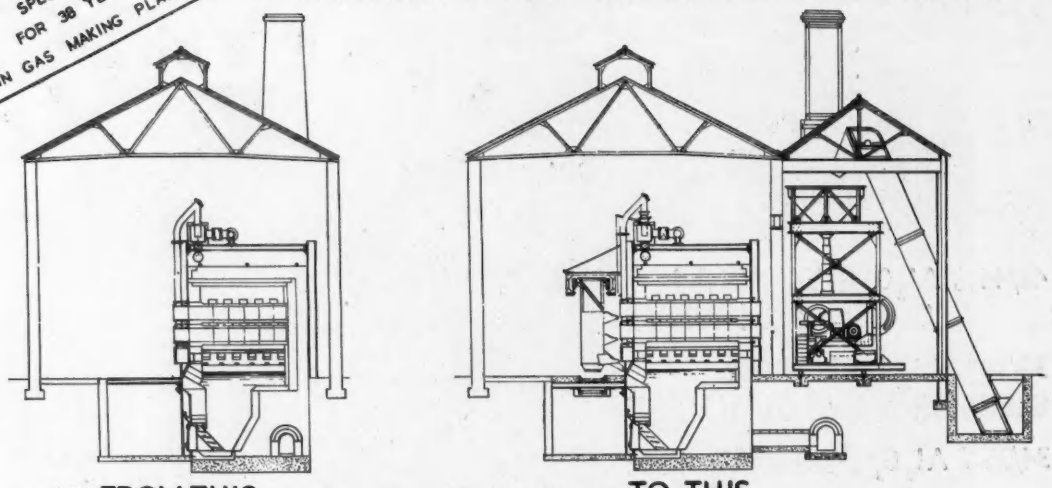

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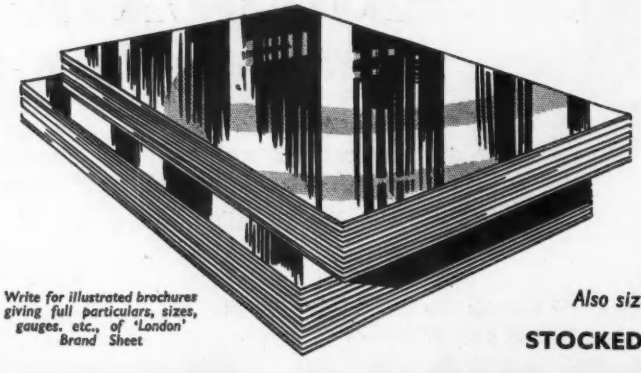

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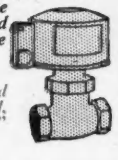

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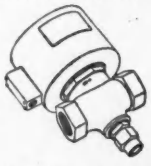

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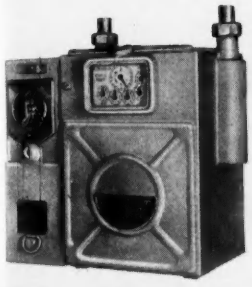

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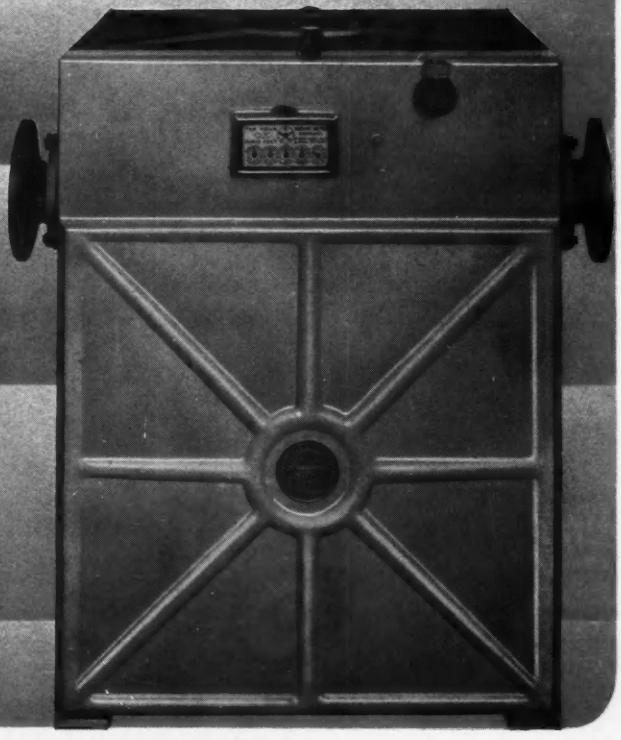

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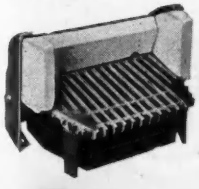

The fuel consumption can be reduced by the air control, although high rates of burning are possible, when desired. The average weekly fuel consumption for winter operation, including overnight burning, should be 1 cwt.

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The efficiency of the Sofono Fire is judged firstly by its power to obtain a high standard of heat comfort at no additional fuel expenditure. Secondly, by its ability to heat water continuously for domestic purposes by means of a back boiler. Thirdly, to remain alight day and night. Fourthly, to be easily lit, when required, by an optional gas burner and, finally, to be simple to install and maintain.

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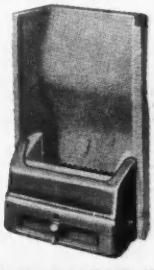

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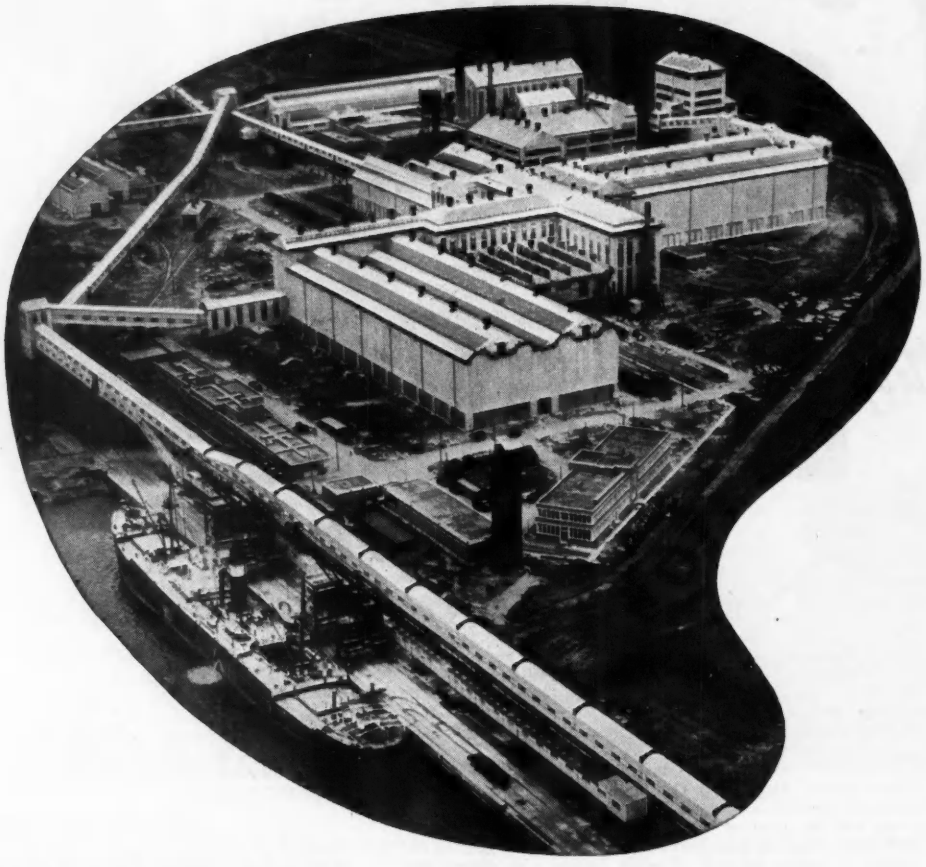

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[Illustration by courtesy of the North Thames Gas Boa

10 *million cu.ft./day C.O.L. Intermittent Vertical Chamber plant at Brentford Gasworks*

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(Illustration by courtesy of the Northern Gas Board

8 million cu. ft./day C.O.L. Intermittent Vertical Chamber plant nearing completion at Howdon Gasworks, Newcastle-on-Tyne Work at site commenced 26-9-50

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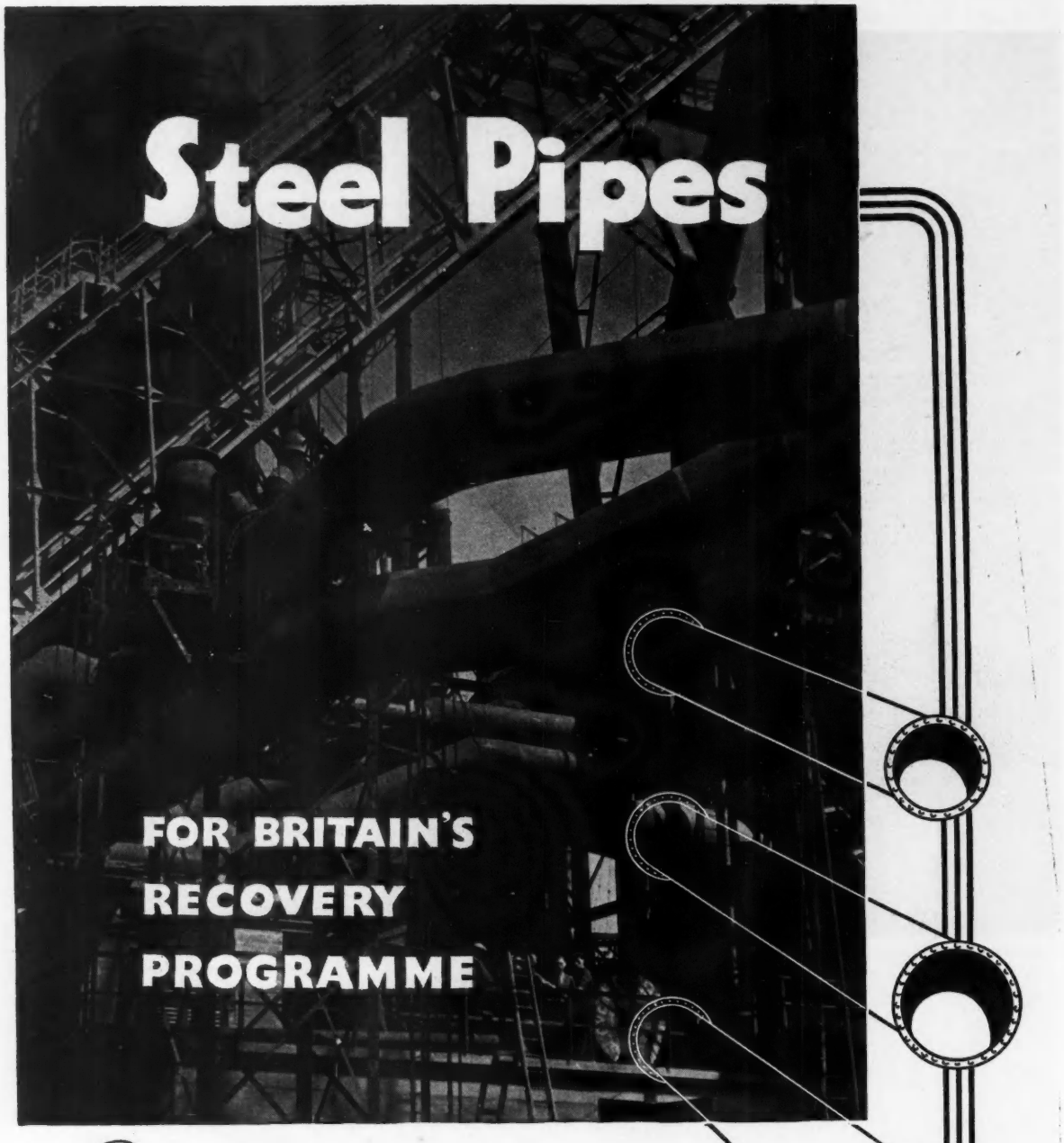

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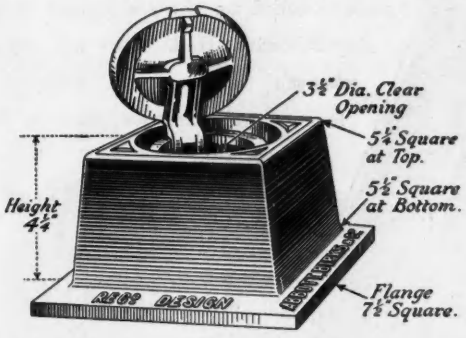

Fig. 102. Footpath and Light Traffic Box.
(Will withstand 4 tons.)

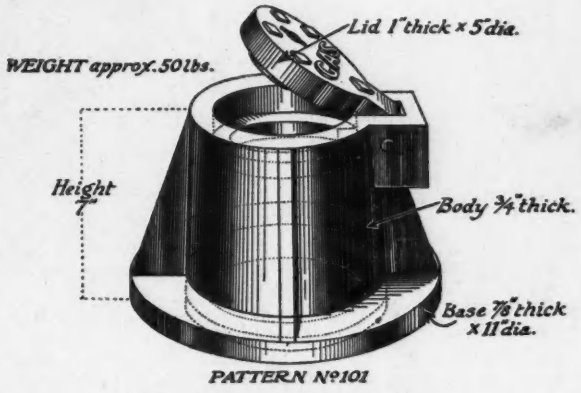

Fig. 101. Heavy Traffic Box.

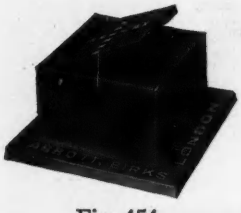

Fig. 454.

Fig. 453.

British Standard Gas Surface Boxes, B.S. 1426.

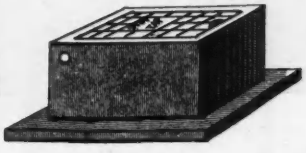

Fig. 1.
Footpath Box.

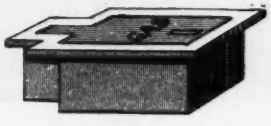

Fig. 5.
Shallow Footpath Box, 2½" deep.

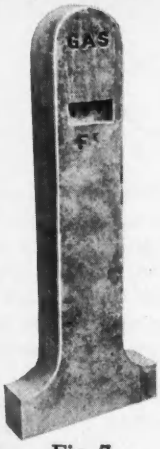

Fig. 7.
Reinforced Concrete Indicating Post to take loose figures or Fig. 1 Plate.

Fig. 1. Aluminium Indicating Plate, to take loose figures.
Size of Plate, 5" x 4"

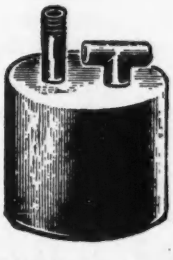

Fig. 132.
Syphon Pots.
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Fig. 36.
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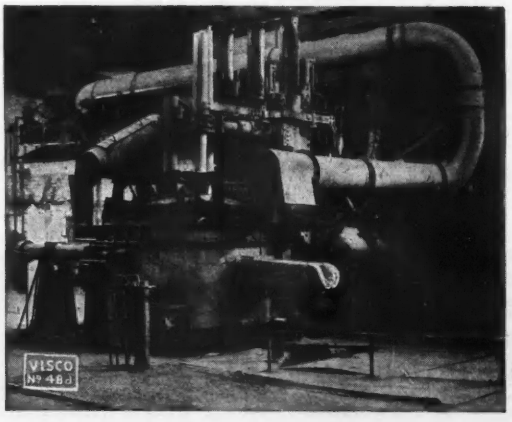

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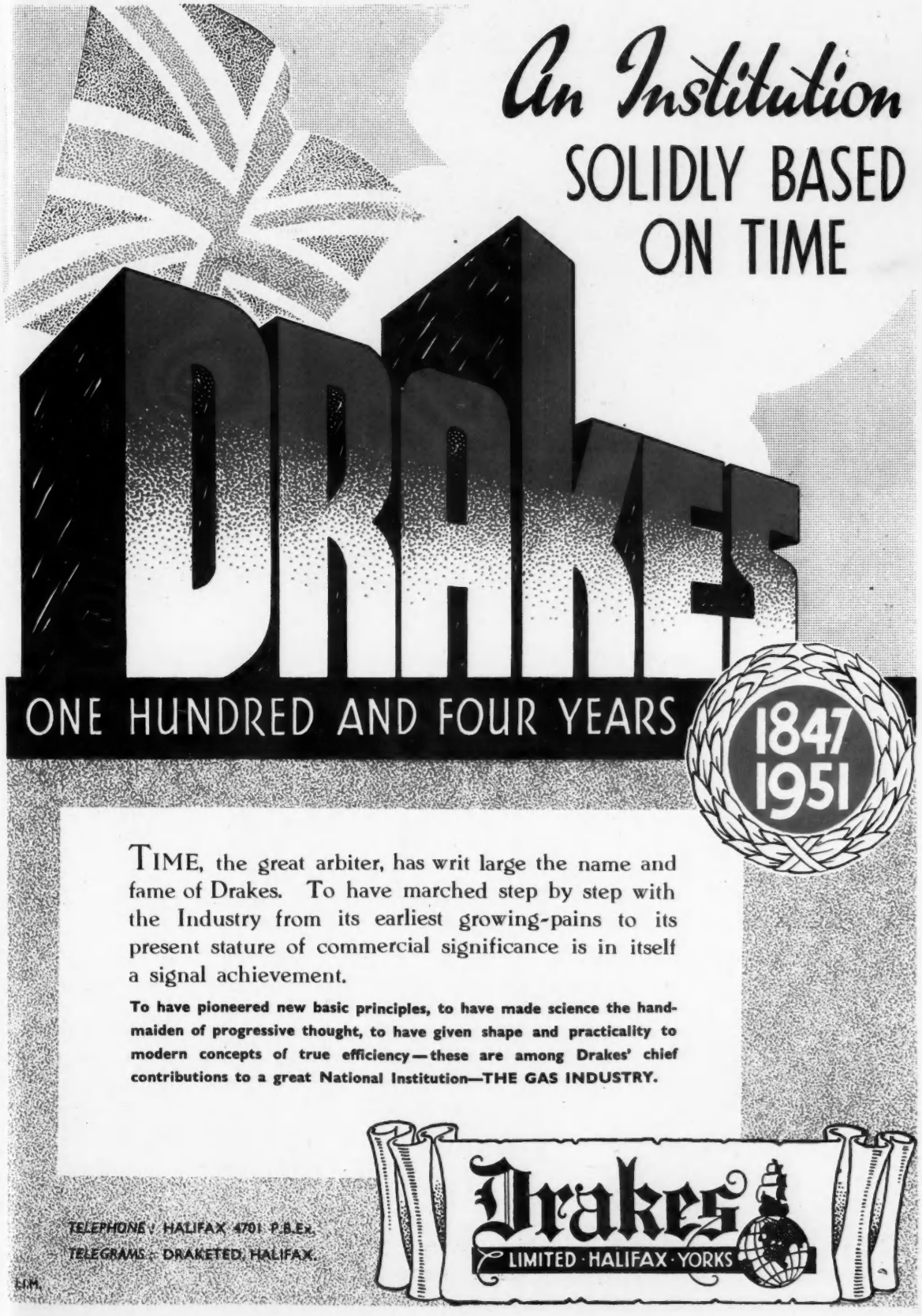
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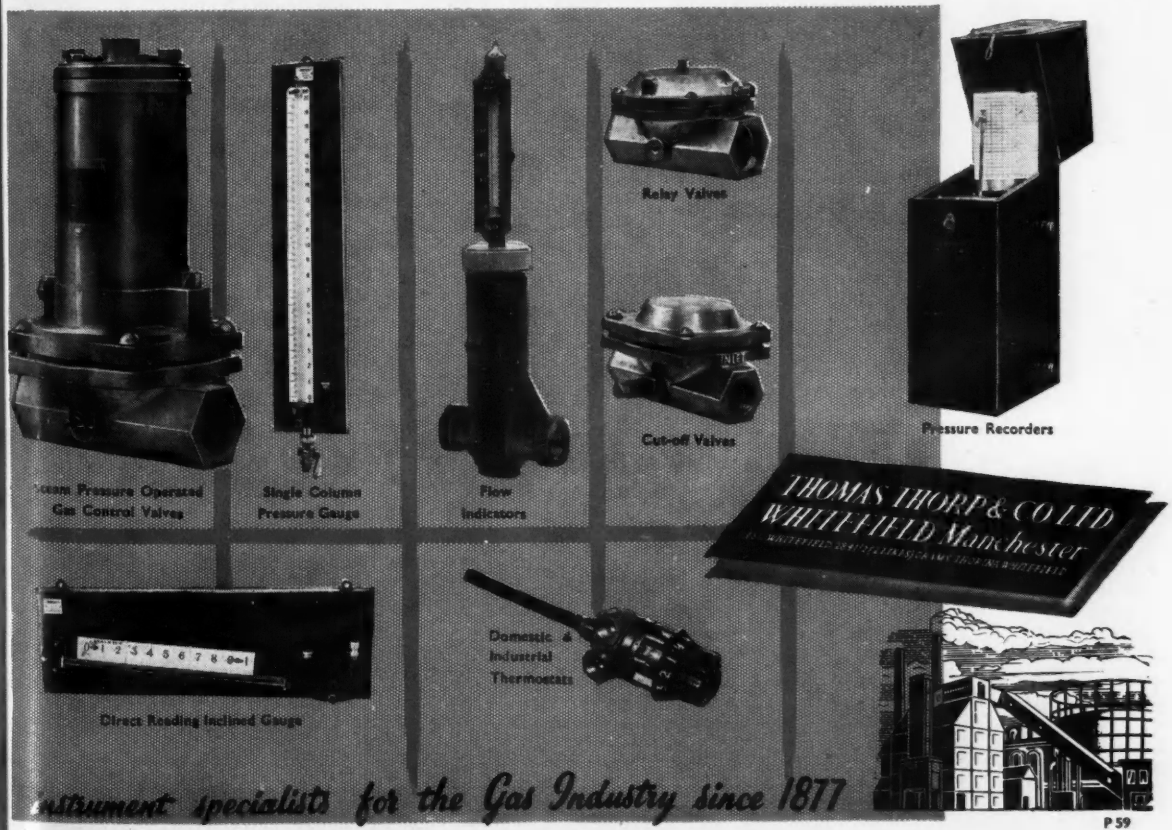

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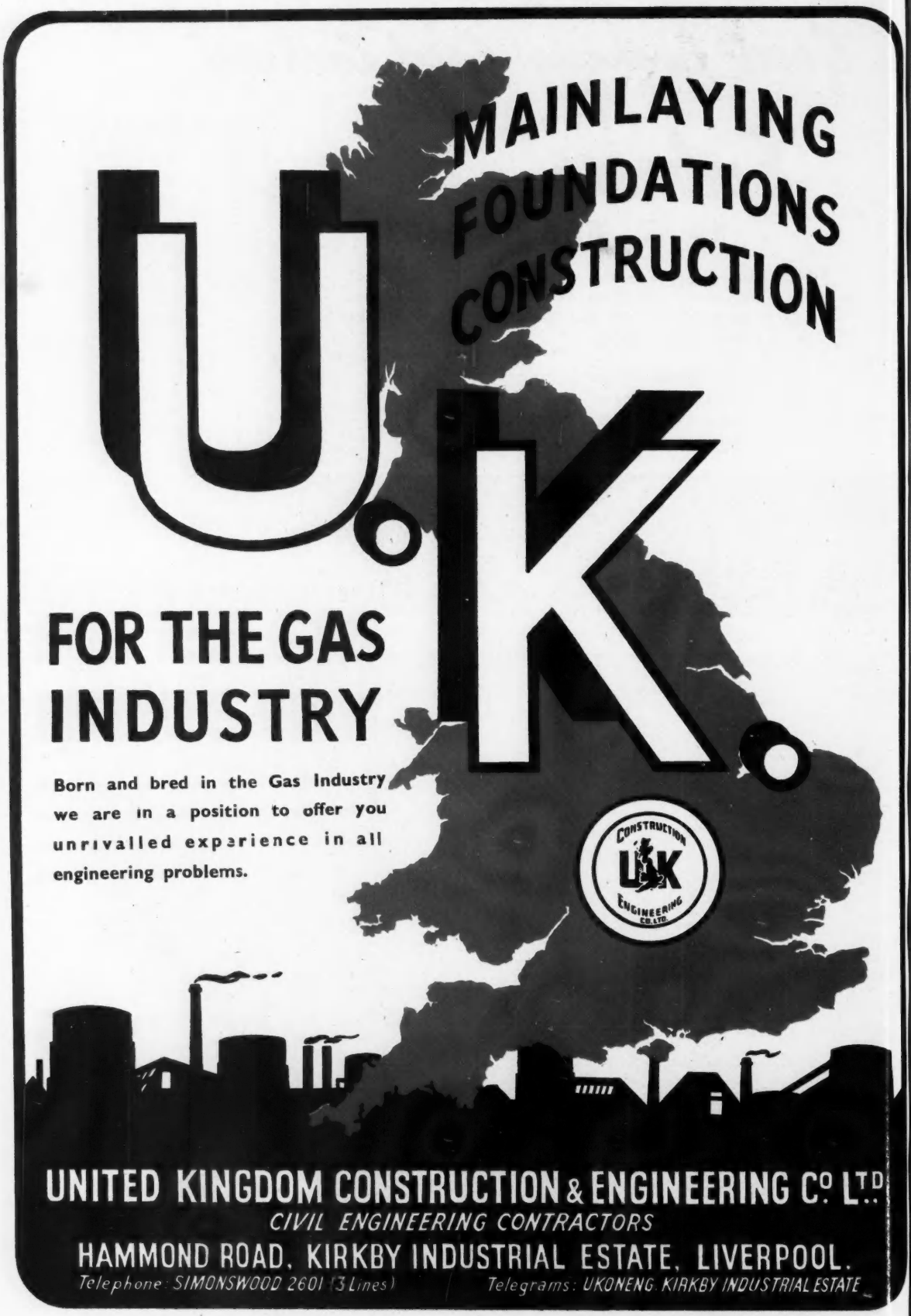
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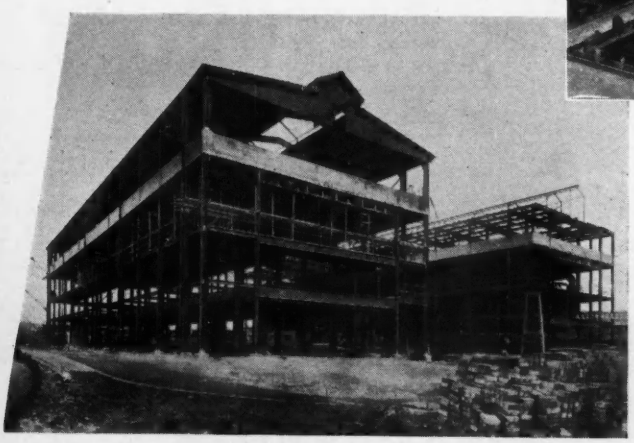

Above and left: Views during erection at Howdon of M.S. electrically-welded Purifiers in steel buildings. Complete installation to consist of three sets of Purifiers each set comprising 4 boxes 40′0″ x 30′0″ x 8′0″ deep with 24″ bore mains and reverse and divided flow valves. Interior view is taken at deck plate level.

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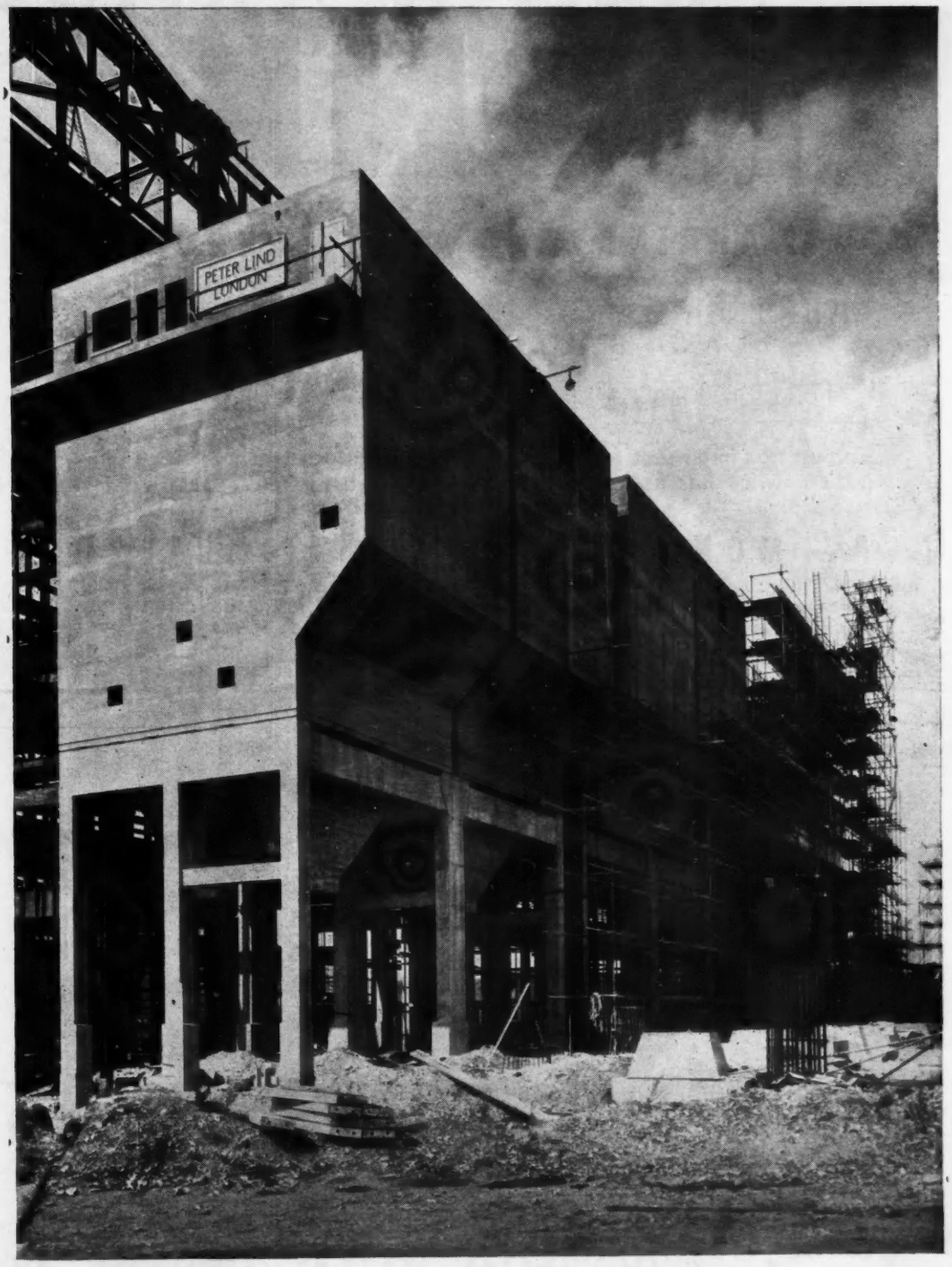

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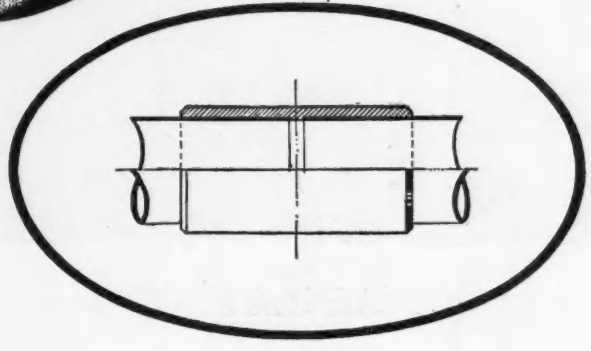

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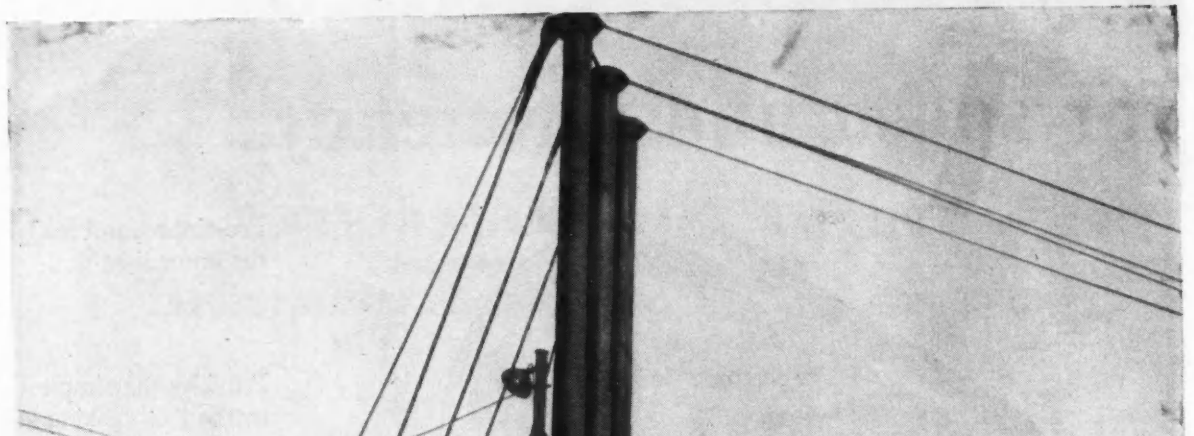

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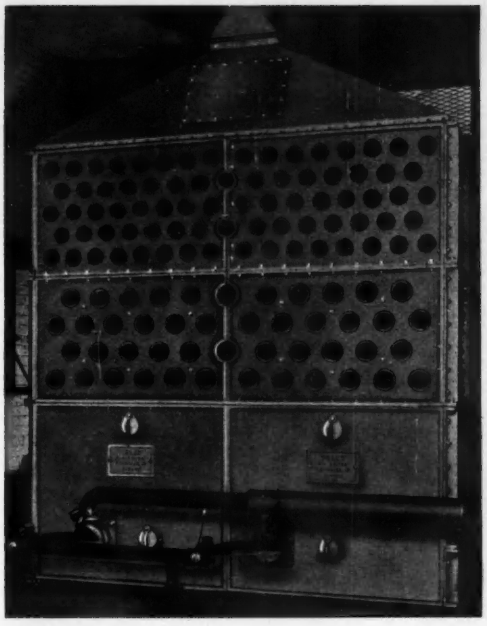

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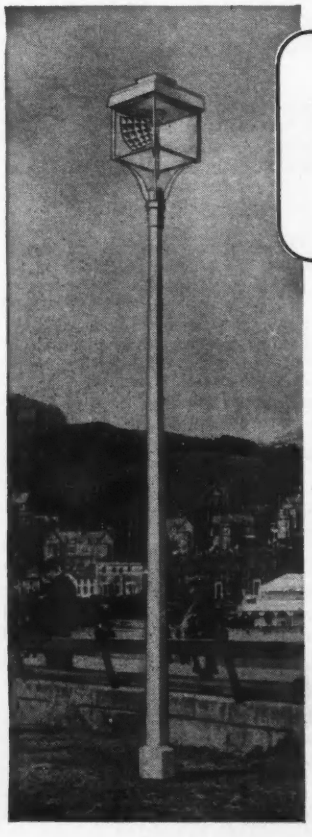

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GAS JOURNAL

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ANNUAL MEETING OF THE INSTITUTION

THIRTEEN hundred registered for the 88th annual general meeting of the Institution of Gas Engineers, May 29 to June 1. At no previous meeting has the attendance been so numerous and so constant throughout every business session. The meeting was held in the Great Hall of the Institution of Civil Engineers under the presidency of Mr. F. M. Birks, C.B.E., Deputy Chairman of the North Thames Gas Board, and the whole flavour of the meeting was London from start to finish. In saying this perhaps we have no need to add that the technical fare was of a very high standard, the papers representing the best and most valuable element of the team spirit. There are many points in favour of a meeting of such size in London, which can absorb thousands without fuss. But this very power of absorption implies impersonal diffusion, and we think that there is a great deal to be said for the holding of summer meetings in other centres. We have, for example, the liveliest recollections of the successful meeting last year at Bournemouth, which was altogether friendly and cohesive. The trend, we think, will be to have many future meetings out of the Metropolis. As was brought out at the President's luncheon on May 29, the gas industry is on the threshold of the greatest expansion it has ever known. Output has doubled in 30 years and already in 1951 it is up by over 8% over the corresponding period a year ago. Coincidentally, membership of the Institution of Gas Engineers has increased by 7%—described by the Minister of Fuel and Power as a 'casual connection.' In the following pages of this special issue of the *Journal* we present what we hope is a colourful account of the meeting as a whole, which was marked in its opening stages by an unusual and highly controversial presidential address which set minds thinking and tongues wagging throughout the meeting—and afterwards. The opening itself was also unusual. Dr. Harold Hartley, President in 1947-48, and to whom more than anyone else the Institution is indebted for 17, Grosvenor Crescent, presented a highly artistic gift in the form of a mace—a fine example of the modern British silversmiths' art. In asking its acceptance Dr. Hartley rightly pointed out that in the English way of life ceremonial plays an important part; the ceremonial arises out of tradition and is at the same time a reminder of tradition. 'The Institution,' he commented, 'dates back nearly 90 years and was granted its Royal Charter over 21 years ago. It has rightly assumed its place among the leading professional bodies of our country . . . It is being called upon to play an even more important part.' Dr. Hartley's gift has added colour and dignity to Institution proceedings and will be a source of members' legitimate pride in the professional body of the gas industry. We have mentioned the controversial nature of Mr. Birks' address. The two highlights were the peak load and tariffs. Regarding the question of tariffs the President asked: 'Am I wrong in suggesting that all two-part tariffs are promotional only in regard to promoting waste?' Then, on the peak load: 'Were it not for the increased specific gravity the pressure reductions for several years ahead would have to be much more drastic than has been found necessary in the past . . . At the present time I cannot help thinking that specific gravity is as good a friend to us as his relative, plain ordinary gravity, has been to all engineers for centuries Specific gravity is a powerful weapon.'

The President of the Institution,
F. M. Birks,
C.B.E., M.I.C.E., M.I.Mech.E.

REVIEW

THE 88th annual general meeting of the Institution of Gas Engineers opened on the morning of May 29 under the presidency of Mr. F. M. Birks, C.B.E., at the Institution of Civil Engineers. Before starting on the agenda, Mr. Birks read a letter which he had received from Dr. Harold Hartley. It was in the following terms:—

'A professional Institution such as ours gradually develops a history and acquires traditions. In the English way of life, ceremonial plays quite an important part; the ceremonial arises out of tradition and is at the same time a reminder of tradition. This Institution dates back nearly 90 years, and was granted its Royal Charter over 21 years ago. It has rightly assumed its place among the leading professional bodies of our country. Further, owing to the reorganisation which is taking place in the gas industry, the Institution is being called upon to play an even more important part in its own particular sphere. It seemed, therefore, that it might be fitting and add something to our dignity if it were agreed to open our meetings with a little more ceremonial than in the past. For this reason with your concurrence, I have had a mace prepared. If agreeable to the members, it might be used at the meetings of the Institution and also when the Council is in session. In that event it could serve as a reminder of the need to ensure that our Institution shall be maintained in high esteem.'

In thanking Dr. Hartley for his generous and artistic gift, Mr. Birks said they must acknowledge it as one of many actions to which they were indebted to him. Dr. Hartley had been a member of Council for nine years, and Mr. Birks said he knew of no-one who has carried out the duties more assiduously. Hartley was President in 1947-48 and a founder member and original member of the Council of the Gas Research Board. To him more than anyone else were they indebted for 17, Grosvenor Crescent, because the whole scheme might well have fallen through but for the great effort he put into ensure its success. They would all remember that he was awarded the Birmingham Medal last year. During the whole of this time he had as well carried heavier and heavier responsibilities in the great concern, Radiation Ltd., that now was fortunate to have him for its Chairman. The mace would be a constant reminder to the Council and the members of the great services which Dr. Hartley had given to the Institution.

Replying, Dr. Hartley remarked that he had spent about two-thirds of his life in the gas industry, and during that time he had formed many friendships and, naturally, he had many pleasant memories. He thought that for the most part these derived from his membership of the Institution.

The Secretary, Dr. W. T. K. Braunholtz, said they had the pleasure of having with them delegates from overseas gas associations and overseas members and visitors. From the Belgian Gas Association they had M. M. Brabant, of Brussels, President of that Association and also President of the International Gas Union. From the French Gas Association were M. E. R. Biard, the President, and M. M. Ferlet. From the Netherlands Gas Association was M. Th. A. M. F. van Mierle; from Norway, the Norwegian Gasworks Association, Mr. John Irminger; from the Swedish Gasworks Association Mr. C. W. Pilo, the President; and from the Austrian Gas Association Dr. J. Steiner, President. From overseas they had two members, Mr. H. Greig, from Rio de Janeiro, and Mr. D. E. Terrace, from Capetown. Then there were overseas visitors from the gas industry—Mr. John Barr, Sydney; Mr. A. Hedley Booth, Johannesburg; Mr. W. W. Pettingell, Sydney; and Mr. D. Scott Young, Adelaide.

M. Brabant, in the name of the delegates of the overseas gas association, said that they in the gas associations of France, the Netherlands, Norway, Sweden, Austria, and Belgium extended thanks, and he addressed the best wishes of the Inter-

national Gas Union to the Institution, which was one of the most representative members of the international organisation.

Dr. Braunholtz then read messages from the American, Danish, and Swiss Gas Associations.

Election of Officers

President, 1951-52: J. H. Dyde.

Vice-President, 1951-53: J. T. Haynes.

Auditors, 1951-52: Colonel H. C. Smith, C.B.E.; E. D. Davey.

Hon. Secretary: J. Terrace.

Council, 1951-54: James Carr, M.C., M.B.E.; H. S. Cheetham; H. F. H. Jones, M.B.E.; K. L. Pearce.

District Members of Council: Eastern, T. C. Battersby; Irish, F. K. Thomas; London and Southern, Dr. S. Pexton; Manchester, T. Haworth (Bolton); Midland, A. Tran; North British, E. G. Smith; North of England, W. O. Kirkwood; South Western, H. H. Brown; Wales and Monmouthshire, J. Powdrill; and the British Junior Gas Associations Joint Council, A. H. Dyer.

Presentation of Medals

At this stage the President awarded medals to H. Stanier, J. B. McKean, F. E. Mills, and F. C. Smith.—(See page 739.)

Presidential Address

We then came to the presidential address (p. 740), an unusual and a controversial one. Broadly, it was divided into two parts—discussion on the peak load and on tariffs. In the course of the address, Mr. Birks remarked that 'the last half century has produced several hundred two-part tariffs based on all and sundry, of which all cannot be either scientific or equitable. Well realising this, I was not so shocked as I might otherwise have been when a month or so ago a friend quite seriously suggested to me that there should only be a flat tariff in each area for all consumers in both industries. The suggestion was put forward purely on a political basis, but on thinking it over it does appear that a more logical and scientific solution to the problem might possibly lie in that direction, and it might well be worthy of careful consideration . . . . Am I wrong in suggesting that all two-part tariffs are promotional only in regard to promoting waste?' Then, on the peak load: 'Were it not for the increased specific gravity the pressure reductions for several years ahead would have to be much more drastic than has been found necessary in the past. I am well aware of the difficulties and inequity of very drastic pressure reduction in that it is not possible to allow for the wide variations of supply caused by elevation, supplies being always best at the tops of high blocks of flats or to consumers on high ground, with a corresponding worsening to those lower down. So I asked my friend, Mr. H. J. Escreet, to calculate for me the reduction of output on days of maximum demand due to increased specific gravity. It transpires that in the North Thames area this can be as much as would be required to provide the gas supply to the City of Liverpool, so you will appreciate that specific gravity is a powerful weapon. I feel sure I am right in saying that if our sister industry had a similar and as massive a safeguard as this at its disposal during difficult times, it would not hide its light under a bushel but laud it to the skies. At the present time I cannot help thinking that specific gravity is as good a friend to us as his relative, plain ordinary gravity, has been to all engineers for centuries.'

Dr. Harold Hartley moved a vote of thanks to Mr. Birks for his address—an address which seemed so

G.J. 3423

The platform at the opening of the meeting. On the President's left sits M. M. Brabant, President of the Belgian Gas Association and of the International Gas Union.

characteristic of the man. He had painted a clear picture, and had emphasised the folly of ignoring fundamentals if they were to avoid failure. His outlook, continued the speaker, calls for a scientific approach in the study of our problems and, embraces an appreciation of the need to collate the facts, in the sure knowledge that when once these are got together the solution will be apparent. I hope that the electricians will study this address.' The President's remarks on gas quality and its control, said Dr. Hartley, reminded him of a conversation he overhead between a chemist, skilled in the design of gas appliances, and a well-known administrator in the industry. The chemist was bemoaning the days that were past when, as he put it, 'gas was gas,' and enlarged on the difficulties which were created for him by the wider variations in the quality of today's supply. Smilingly the administrator sympathised with him, but then he said—after a pause suggesting deep thought—'You know, I am afraid we have got to realise that these engineers have come to stay.'

'To suggest that our President, who certainly came to stay, has no thought for the other fellow would be quite wrong. Associated with Mr. Birks' name is a flame matching burner. I do not know what led him to devise this useful test burner. I have wondered at times whether he was doodling at a meeting and found himself writing the initials F.M.B. and then later expanding them into the term Flame Matching Burner. However that may be, we have the burner and it is very useful.

'There have been discussions during the past year on the subject of the professional qualifications which shall be a pre-requisite for election as an Associate of the Institution.'

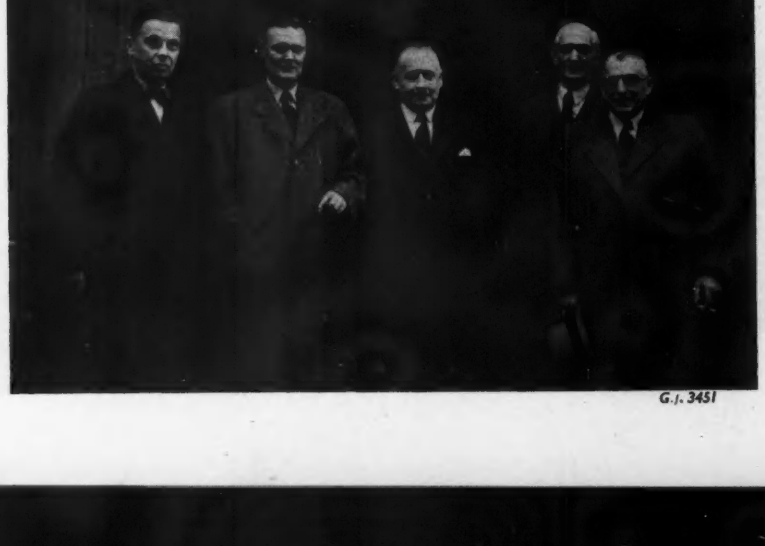
The vote was seconded by Sir George Evetts, O.B.E., who remarked that they agreed that tariffs were today one of the major headaches, particularly since the grouping under nationalisation coupled with the very high cost of plant and equipment. As the President had pointed out, the word 'promotional' had been mis-applied. They had started with the idea that promotional sales promoted their financial stability, but it had not worked out like that. Sir George continued 'I remember that the National Gas Council spent quite a long time on this matter. We endeavoured to ascertain the financial effect of the introduction of some of the more important promotional tariffs. We could get details of the increased consumptions quite readily, but we could never find out whether the increased gas sold was produced at a profit and, if so, at what profit. We introduced tariffs originally to improve the financial position of the undertaking by increased sales and to do justice to the consumer who suffered financially under the flat rate system. So I can imagine that the President's suggestion in referring to the flat rate will cause a lively difference of opinion. Some of us wonder what will happen to our industrial loads where one single customer may take as much as 1,000 of the ordinary domestic consumers. But the form of tariff against which we must guard is that which involves selling large quantities of expensive gas at the lowest price, and I imagine that that was what the President was driving at in his warning.'

Gas in Belgium

This brought us to the presentation by M. M. Brabant of his paper 'The Development of Gas Production in Belgium: 1900-1950.' He said that in Belgium it was logical that the coke oven should remain one of the chief means of producing gas, for coke was the corner stone of their steel industries and should, therefore, be available in sufficient quantities in the country itself. But the Belgian gas industry, at present too closely connected with the coking and metallurgical industries, was in such a state of vassalage that it must try to break free. Submitted as it was, by its nature as a transforming industry, to all the upheavals, all the shocks that might occur in the market for power, it must guard against them. Taking normal evolution into account, it was agreed that in Belgium they had, or would have, supplementary sources deriving on the one hand from the gas from petroleum refineries, on the other from methane from coal mines rich in firedamp—valuable and important sources. Holding out a hand to the coal and petroleum industries, the gas industry would find in them valuable and abundant supplies that would enable it to benefit from the greatly enlarged and more adaptable supplies of town gas.

Following discussion on the paper the meeting adjourned, and in the interval the President's luncheon was held at the Savoy Hotel, the guest of honour being Mr. Philip Noel-Baker, Minister of Fuel and Power. Our report of the occasion will be found on p. 774.

On resumption in the afternoon there was before the meeting a 'symposium' of short papers submitted



G.J. 3451

Left to Right: C. W. Pilo (Swedish Gas-works Association), J. H. Dyde, (the new President of the Institution), C. H. Chester, O.B.E. (Past President), J. T. Haynes (Junior Vice-President) and Charles Averill.

J. R. W. Alexander (Executive Chairman, Gas Officers' Guild) greets Colonel W. M. Carr, C.B.E.

G.J. 3448

by the British Junior Gas Associations' Joint Council. Mr. B. H. Cunningworth (Midland Juniors) dealt with coal assay on a small scale test plant; Mr. W. Graham (Northern) with automatic regulators and their use in gasworks; Mr. J. F. Waight (Midland) with the design of tunnel burners. Discussion on the papers brought the session to a close.

Masterly Presentation

One expects much of Dr. J. Burns, Chief Engineer of the North Thames Gas Board, and the masterly way in which, on the Wednesday morning, he introduced his paper dealing with gas manufacturing practice in the North Thames area put everybody in good form. In this paper the author described the Board's grid and discussed the conditions under which it is economic to interlink one manufacturing station with another. He discussed further the factors involved in determining the site of new and additional plant in an interlinked system. Given an interlinked system, he considered the particular aspects of operation associated with variability of load, and described some of the means that have been developed to estimate in advance the day-to-day and season-to-season requirements, and outlined the advantages of such prior knowledge. The various types of plant at the disposal of the gas engineer were reviewed from the particular aspect of the economics of operation, and the author described the most suitable combination of plants to meet a variable load. Factors other than economics, which may determine the choice of carbonising plant, were dealt with, and Dr. Burns went on to review some of the improvements that are being applied by the North Thames Gas Board to carburetted water gas plant design. The trends in purification, and the design of purification plant, in the Board's area were discussed, as also were the economics of steam and power provision on works of different sizes. A special feature was made of the factors affecting the most suitable choice of steam raising plant to meet a variable load; and the author dealt with the place of the waste heat turbine in gasworks, and indicated possible applications for the power produced therefrom. The particular form of staff organisation to operate an interlinked system was shortly reviewed.

There followed a general meeting of contributors to the Benevolent Fund, a report of which will be found on p. 745.

Storage of Coal and Coke

The other paper on the Wednesday morning was by Mr. L. J. Clark and Mr. J. H. Walker, North Thames Gas Board, on the subject of the storage of coal and coke in the gas industry. In this contribution the authors pointed out that during the last decade there have been many changes in the balance between production and marketing of solid fuel. This has had its effect upon the position of coal supplies and coke marketing in the gas industry and has necessitated some changes in policy concerning the stocking of these materials. There have also been significant developments in the methods and types of equipment available for handling coal and coke to and from stock, and advantage has been taken of the generally increased flexibility of the new handling systems to meet the more stringent requirements of the present day.

Fundamental Requirements

The authors considered the fundamental requirements for stocking coal under three headings: short term buffer store equivalent to about one day's demand; intermediate store with a capacity equivalent to about seven days' demand; and long term store with a capacity equivalent to five to six weeks of demand. The most suitable types of equipment and plant to perform these different duties were discussed, and their operating costs and general economies compared. Some actual plants now being installed at the larger stations of the North Thames Gas Board were described, together with the general technique adopted for their operation.

Practical data were given concerning the deterioration of gas-making coals when stored for several months, and in general the thermal yields are found to drop by three to five therms per ton after six to 12 months storage. Methods developed in America for reducing the degree of deterioration by compacting or sealing were described and related to the recent experiences gained by the Board.

The special requirements of the coke market in relation to the needs

A. Nicholson (Blackburn) with T. Haworth, Chairman of the Manchester and District Section of the Institution.

G.J. 3456

for coke storage were examined. The general policy of the North Thames Gas Board is to stock only graded coke and to debreeze all grades of coke when loaded for sale. It is generally recommended that facilities for storing up to 20% of the annual coke production should be provided, but it is not necessary for this to be uniformly allocated to all works. Practical experience in operating and handling coke on three large storage grounds has shown the advantages to be gained from utilising flexible and mobile plant in the form of lorries, excavators, draglines, mobile shovels, etc., and simple portable debreezing units, for this purpose.

The significance of coke degradation and breeze production in handling and storage was discussed, and data were given to indicate the extent to which this occurs under different conditions. Methods used to reduce the breakage of coke in bunkers and handling to and from stock were described, and the results of various tests quoted. Finally, the need was emphasised to improve the strength and quality of coke by more complete control of the quality of the coal carbonised. Although this is to some extent beyond the control of the gas industry, significant improvements can be effected by adequate blending and so on.

Two papers were presented and discussed at the closing session of the meeting on the Thursday morning, the first being by Mr. J. E. Davis and Mr. C. Stott, South Eastern Gas Board, bearing the short title 'Horizontal Retorts.' The former South Metropolitan Gas Company traditionally not only used horizontal retorts as its sole gas-making plant, but also designed and constructed this plant with its own staff, but after the end of the 1939-45 war a project was formulated and work commenced on the replacement of some of this carbonising plant by coke ovens and by water gas generators. The purpose of this joint paper was to review the experience over the past 30 years in the design and operation of horizontal retorts, and to show how the thoughts that were behind this progress led naturally and logically to a departure from the horizontal retort to the coke oven at the East Greenwich gasworks. In retrospect it is easy to see that attempts to develop in certain directions were doomed to disappointment from the start, but the unsuccessful are placed on record

G.J. 3461

Many from Wales . . . .

alongside the successful, for the experience was dearly bought and will have value to others. The paper consisted of a general section in which was outlined the thought that lay behind the various changes made in design and in operation, and the degree of success attained in reaching the defined objectives. In the course of this narration it appeared that the desirability of changing the type of carbonising plant was recognised some 20 years ago, but the opportunity to take this step did not arise until the increase in gas demand at the conclusion of the war. In nine subsequent sections more detailed consideration is given to individual features of design and operation.

A General Review

In a general review of the whole situation the authors stated that in 1921 the late Mr. G. M. Gill, then Chief Engineer to the former South Metropolitan Gas Company, presented to the Institution of Gas Engineers a paper on carbonisation in horizontal retorts, and he then outlined certain desiderata that he described as 'special requirements of the present time.' Although 30 years have elapsed, these desiradata, the authors went on to say, are still the same and they have not changed in the interval. They are:—

(1) To obtain the maximum duty from carbonising plant on account of its very high cost.

(2) To obtain the highest possible yield of gas and other products from the coal.

(3) To improve and to maintain good working conditions in the retort house.

The first requirement can be considered under two headings—namely, the daily throughput per unit of plant, which determines the total capital required to be invested, and the life of the plant, which, of course, represents the life of the capital investment.

Through the 30 years the coal carbonised has consisted of Durham and Northumberland run-of-mine, and the retorts employed have remained of oval section 21 in. × 15 in. × 20 ft. in length, except for a short period when oval retorts of a larger cross-section were tried. At the beginning of the period the weight of charge carbonised in 10 hr. was 10½ cwt. In the more recently built sections it is now 13¾ cwt. At the time of the earlier paper the average life of a retort was 1,500 working days and the weight of coal carbonised during the working life of a retort was 1,750 tons. Today it is considered reasonable to expect a working life of 4,000 days, during which period the retort will carbonise 6,000 tons of coal. In 1921 a gas yield of 70 therms per ton was considered a good performance, but, as charges became heavier and the general technique of operation improved, yields rose in the pre-war years to as high as 75 therms (of 560 B.Th.U. gas) per ton. The depreciation in coal quality as a consequence of the war has brought the figure to 72½ therms, which represents a standard of performance equivalent to the 75 therms on coal of pre-war quality. By 1921, a daily make of 90 therms per retort had just been reached. In recently constructed settings the make approximates to 120 therms per retort.

Attention to Detail

In the main these improved results have been obtained not by radical departures in design, but by attention to detail, in both the construction and the operation of the plant. In this, the staff of the former South Metropolitan Gas Company had a number of advantages. With only one type of plant to be operated, the whole of their attention could be given to understanding that type of plant thoroughly, and as all constructional work was carried out by the Company the lessons learned in the operation of one unit could be applied to modifying the design in those units to be erected in the following year. Furthermore, the number of horizontal retorts was such that each year there fell due for reconstruction not a few settings within a bench, but one or more entire benches, a bench generally consisting of 15 to 16 settings.

The scale of working at each of the works was sufficient to justify the employment of retort house testers who, by making frequent analyses of waste gases and determinations of combustion chamber temperatures, permitted the settings to be worked continuously within a comparatively narrow margin of their maximum capacity.

In general design the horizontal retort setting of 1950 resembles closely that of 1921. The retorts are now constructed of silica segments, proper provision is made for expansion so that the inevitable changes of dimensions on heating-up do not distort the structure, producer capacity both in grate area and in coke capacity is more generous, and scrubber standpipes have taken the place of ascension pipes. Coke is quenched and removed from the retort house by the Fleuve system, and the disposition of producers is such as to make the removal of ash and clinker much easier. But this is not to say that there have been no attempts at more radical departures. Even in 1921, the retort houses at the Old Kent Road gasworks were provided with producers external to the retort house, the producer gas being conveyed hot through brick lined steel mains to recuperators beneath the settings. The object had been twofold—to remove the work of filling and clinkering producers from the retort house, so improving the working conditions there, and to prolong the life of the settings by settling the dust from the producer gas before it entered the settings.

During the years 1925 to 1935, attempts were made to carry this line of development further by the introduction of steel cased external

G.J. 3466

Dr. J. Burns, G.M., at the microphone.

producers with hot filtration of the producer gas, and improved designs of recuperators. All these attempts must be considered to have failed. The work of producer operation, which was transferred from the retort house to an adjacent generator house, still had to be done and experience showed that the cost of doing it in the separate generator house was higher. Some success attended the efforts to remove the coarser dust from producer gas, but it was not this that did damage to the refractories. The fine dust continued to be fused in the producer gas flame and to cause slagging of the outer surfaces of the retorts, and indeed this effect was aggravated by the vapours of sodium salts derived from the water used to quench the coke supplied to the external producers, whereas the coke fed to internal producers was unquenched.

Recuperators and Regenerators

These experiences led to the conviction that if producer gas were to be cleaned, partial cleaning was useless and the job must be done thoroughly. This meant that the sensible heat of the producer gas had to be sacrificed entirely and much more efficient recuperation or regeneration would be required. It had not proved possible to design recuperators that would be both efficient in transferring the heat of the waste gases to the incoming producer gas and secondary air and at the same time remain gas-tight for a reasonable period of years, and invariably settings provided with external producers showed fuel consumptions substantially higher than the settings served by built-in producers. An attempt was made to apply regenerators to horizontal retorts, these regenerators being fed with cold, washed producer gas. Technical success was achieved, but the capital cost of the regenerators and the necessary change-over gear was inordinately high, owing to the small coal capacity of the retorts served by each pair of regenerators.

Thermal Efficiency

In the course of this work and in related work that was carried out to improve the heating of the retorts on the flue side and so increase their throughput, heat balances were prepared showing the source of heat losses, and it was realised that how-

G.J. 3432

And many from the North East.

G.J. 3440

J. S. Smith, O.B.E. *(Ministry of Fuel and Power), S. Langford (Robert Dempster & Sons, Ltd.), and D. D. Burns, (Deputy Chairman, Scottish Gas Board).*

ever great a degree of success might be achieved in improving the throughput per retort and extending the life of the settings, horizontal retorts must always suffer from the limitations imposed by the high external heat-losing surface per unit of coal carbonising capacity and by the multiplicity of operations involved per unit weight of coal carbonised. The high ratio of heating surface imposed a limit to what could be achieved in the way of thermal efficiency and the multiplicity of operations to anything that could be done by way of reduction in carbonising wages or maintenance costs.

A Comparison

From 1928 to 1932, tests were carried out on coke ovens in England and on the Continent, covering the normal type of coke oven used for the production of metallurgical coke and ovens of smaller size, which had been adapted in Germany for gasworks use. By comparison with the information obtained in horizontal retorts, it was clear that the full-size coke oven provided an arrangement in which the heat-losing surface per unit volume of coal carbonising capacity was much reduced, and to which efficient regenerators could be applied without undue capital cost. As the weight of the charge in ovens is about 20 times that in horizontal retorts, the number of operations required per unit weight of coal carbonised was reduced in approximately this ratio, leading to possible savings in both operating and maintenance wages. Indeed, at that time it was considered that under the conditions existing at the East Greenwich gasworks, coke ovens should show a saving of about ½d. a therm, as compared with horizontal retorts, but to obtain these advantages it was necessary to install plant with a capacity of not less than 1,000 tons of coal a day. There was then no opportunity to do this. From 1921 to 1931, the output of gas by the former South Metropolitan Gas Company had grown steadily, but the improving technique in the operation of horizontal retorts had given a 20% increase in the output per unit of plant, and, although settings that had been worked out were renewed year by year, there was no case for building additional plant. Had sales of gas continued to increase, however, the time would have arrived when new plant would have been necessary, and coke ovens could have been installed; but, from 1931 onwards, a recession in business took place, due largely to the loss of the lighting load and to movement of the population from the area of supply of the Company to that of adjacent companies, and the opportunity to install coke ovens did not occur until increasing demands for gas, combined with areas of renewals during the war period, made it essential to erect new plant from 1945 onwards.

Meanwhile, another difficulty had occurred. Today, an installation consisting solely of horizontal retorts would be regarded as embarrassingly inflexible, but this had not always been the case. In the early 1920s, it was possible to adopt a method of working that catered for the variation in gas demand from summer to winter and from week to week. Retorts lasted only 1,500 days, and indeed to make them last this long repairs to the retorts themselves, to the combustion arches (which not infrequently would collapse after two winters' work), and to producer linings, meant that the summer recession in demand was a welcome opportunity to carry out necessary retort house repairs. It was possible to employ labour in the retort houses during the winter months and to transfer it to setting repair work in the summer time, added to which there was alternative employment locally during the summer months for the less skilled labour, and work in the gasworks during the winter months was a welcome alternative to unemployment during the winter, when outdoor work was less readily available. These circumstances permitted seasonal variation to be accommodated comfortably.

Meeting a Variable Demand

Variations in demand from week to week were met by varying the amount of Sunday work. It was customary to discontinue gas-making from 6 a.m. Sunday to 10 p.m. Sunday, with a view to giving the men a break and to avoid employment at double-time rates. Normally, the holders would be full by 6 a.m. Sunday and gas was taken from stock during the period of shutdown. If, however, by Saturday evening it was clear that the demands during the week would prevent the holders from being full on Sunday morning, either one or two shifts could be worked on the Sunday, this giving a 10% variation on the week's gas production. An unusually warm spell would not be accommodated by this device, but would need 12 hr. or even 20 hr. carbonising periods during the week.

During the years when the weight of charge did not exceed 11 cwt. or 11½ cwt., it was possible at times of exceptionally high demand to carbonise this charge in 9 hr., giving a further 10% gain over and above the rated capacity of the plant.

The Problem of Repairs

But circumstances were changing and, as success attended the efforts to prolong the life of retorts and settings, a smaller proportion needed repair each summer, and the position arose when settings were being let down in the summer-time only because they were not needed for gas-making, and the cooling down of

the structure made necessary the repairs that would not have been needed had the plant continued at work. The increase in weight of charge was made possible only by working the settings more nearly to the safety limit, and this greatly reduced the possibility of emergency 9 hr. work.

Continuity of Employment

It was foreseen before the war, and realised after the war, that all men employed must be given an assurance of continued employment and that the distribution of process work over the seven days of the week must be uniform. With these changes in circumstances, plant which had once been able to provide the desired degree of variability became highly inflexible, and it was realised that carbonising plant, whether horizontal retorts or the coke ovens that it was hoped to install, could be regarded in the main only as base load plant, and that variations in demand must be met by plant of another type.

The East Greenwich gasworks is well situated for the receipt of coal direct by ship from the North, and for disposal of coke by rail, road, and water, and in these circumstances the coal gas therm is cheaper than the carburetted water gas therm at 500 B.Th.U. so long as the annual load factor on the carbonising plant is not less than 50%. Therefore, although the installation of water gas plant was indicated in order that carbonising plant might be operated at level load from day to day and at the best load factor over the year, it was equally necessary that as high a proportion as possible of the total therms produced per annum should be coal gas therms. A degree of flexibility in output adequate to meet fluctuating demands from day to day and from week to week throughout the year can be provided by alternative dilution of the rich coal gas made in coke ovens and horizontal retorts down to a declared calorific value of 500 B.Th.U., the alternative diluents being producer gas and blue water gas. When producer gas is used as the diluent its low calorific value of 125 B.Th.U. permits the addition of only about 13% by volume, but with blue water gas of 290 B.Th.U. the proportion of diluent gas is increased to about 23%. Thus, a 10% increase in the output of a works can be obtained.

There remains, however, the problem of meeting short-lived peak demands in the winter months, and for this purpose, pending the development of more appropriate processes, carburetted water gas has the advantage of low capital costs in relation to daily output. Thus, in planning the new installation for the East Greenwich works, coke ovens were visualised as carbonising plant for the full base load of 365 days per annum, with some horizontal retorts remaining for operation during the spring and autumn months, the total installed capacity of carbonising plant being approximately equivalent to the mean day's output. If the mean day's output be taken as 100, provision has to be made for meeting a maximum demand equivalent to 160, and, of the additional 60 volumes required, 30 can be provided by blue water gas used as a diluent for the coal gas and the balance of 30 volumes by carburetted water gas of 500 B.Th.U. In such circumstances, the programme of operation can be arranged to provide between 80 and 85% of the total therms made in the year in the form of coal gas, and it was on these principles that the redevelopment of the East Greenwich works was planned.

Introducing the paper, Mr. Davis said that he and his partner had described the development and the ultimate form of a special instance of horizontal retort practice. The features of the design and construction of the settings, the ancillaries and the stoking machinery, had been set out together with the methods of operation and control. The working results from the modern form of plant carbonising Durham run-of-mine coals, showed that in a 20 ft. retort of 21 in. × 15 in. oval section, an even charge occupying 95% of the theoretical capacity of the retort could be laid at all times, giving a gas output of 115 therms per retort per day, with a yield of 72 therms per ton of coal carbonised. The calorific value of the gas produced was 595 B.Th.U. per cu.ft. and the inert content was less than 10%. The fuel consumption on producers was 17 lb. of dry coke per 100 lb. of coal carbonised, or 13¼ lb. when credit was taken for the thermal value of the steam raised on waste heat boilers. Retort life approached 5,000 working days and incurred four repair schedules. There was strong evidence that as experience with the silica segmental retort installed in recent years was extended this repair work would be substantially reduced.

Co-ordination of Design

There was, he said, a second aspect of this record of work which was fundamental to technical progress in any branch of the industrial field. It would be appreciated that the design and installation of the retort settings and all ancillary plant was carried out by their own engineering and technical staff. He did not want to make too much of that point, because he did not want there to be any misunderstanding; nevertheless it was a fact that this was a procedure which resulted in the closest co-ordination of plant design and process operation.

G.J. 3454

D. D. Melvin (Scottish Gas Board), F. R. Mitchell (President, North British Association of Gas Managers) and James Carr, M.C., M.B.E. (Bristol).

Carbonising plant comprising 3,500 retorts set in 25 retort benches, entailed a regular succession of plant renewal in which amendments in plant design had been progressively incorporated. This identity of interest between design and process was an over-riding factor in technical progress. This close relationship and the consequent continual spur to development of design, demanded the definition and evaluation of the materials of plant construction. This involved the adoption of a system of specification and inspection set up to cover all aspects of fabrication and construction and of material supply.

G. J. 3434

T. C. Whimster, W. L. Hurdman, and R. J. Rogers, all of the Parkinson Stove Company.

Distribution in North Thames

The final paper of the meeting was by Mr. A. B. L. Copp, North Thames Gas Board, and dealt with the distribution development in the western area of the Board. On vesting day, 1949, the Board acquired the assets of the Gas Light and Coke Company and 11 other undertakings. Of these, five adjoined each other at the western end of the Board's area, and each possessed manufacturing stations except the Chertsey undertaking; the Slough, Windsor, and Ascot companies had one each, while the Uxbridge company possessed works at Uxbridge, Amersham, High Wycombe, Marlow, and Maidenhead, and took bulk supplies from both the Gas Light and Coke Company and the Watford and St. Albans company. Most of the areas of these five undertakings are developing at a rapid rate, and the future of their supplies after vesting day had to be determined at a very early date. The distribution systems existing had been built up over about 100 years on the basis of no co-ordination and were barely able to meet the demand for gas. In order that all aspects of a main-laying programme sufficient to fulfil requirements for the next 30 or 40 years could be considered, it was necessary to examine all features of development—that proceeding, that probable or planned, and that which appeared reasonably possible. An estimation of the demand to be expected from each individual parish was made.

Economies of Riverside Stations

It was thought that it would prove more economical to make gas at the large riverside Gas Light stations of the Board than further to extend those of the absorbed companies in the west, and in order to arrive at a cost of gas delivered throughout the area in question, a grid system was devised, and estimates made of the cost. In the paper the economics of bulk supply were summed up and figures given of cost for manufacture and transmission of gas from large riverside stations through the existing and proposed grid systems, and also a figure equivalent to the cost of transporting coke for local sale. A note was added drawing attention to the differences between conditions of supply in the western and eastern areas of the Board. The execution of works involving the laying of gas mains of large diameter is often beset with engineering difficulties. Some of these have already been encountered, and those that appear to be of general interest were described and illustrated in the paper. Appendices were added in which statistics were presented of gas storage capacities and of inclusive costs of manufacture and transmission.

Introducing his paper, Mr. Copp remarked that nationalisation of the gas industry, and the formation of area boards in 1949 greatly accelerated the slow progress that was being made in various forms of amalgamation and integration, which linked up one undertaking with another. The statutory charge 'to develop and maintain an efficient, co-ordinated and economical system of gas supply for their area and to satisfy, so far as it is economical to do so, all reasonable demands for gas within their area,' had been taken up with enthusiasm by all the boards. This necessarily required that a thorough examination be made of the economics of giving bulk supplies from those manufacturing stations able to supply cheap gas to those in a less advantageous position, and the planning of suitable mains and storage stations so that the adequate supplies called for might be available.

Each gas board, he continued, possessed individuality, and diversity of conditions within the areas of the various boards made comparison between their methods and results difficult to apply for arriving at approved policies giving optimum advantages. The North Thames Gas Board was peculiar not only because it sold an enormous quantity of products in a very small area, but because it included the former Gas Light and Coke Company. Such was the vast size of that Company that it represented nearly nine-tenths of the Board's present business. It possessed many efficient manufacturing stations and a grid distributing system of great capacity linking the stations together, carrying gas to holder stations, and, through 100 underground district governors, assisting to give consumers a constant supply free from notable variations in pressure.

The former Gas Light and Coke Company in its long history had already absorbed close on 50 original undertakings; it had, therefore, experience and traditions that gave smooth continuity in implementing

the Gas Act of 1949; and there was the fortunate continuity of direction which was preserved. Integration of those former undertakings that supplied the built-up metropolitan area was clearly the proper policy to pursue, and as each had a well developed and comparatively adequate distributing system all that was required was to lay mains connecting the various gasworks with the nearest effective point of the 'Gas Light' grid. The western end of the Board's area, however, was entirely different in characteristics from any other part. Although largely rural, it nevertheless contained some considerable towns, of which three may be termed industrial—*viz.*, Slough, Uxbridge, and High Wycombe. The consumption of gas was increasing steadily at a rate exceeding 5% per annum, due both to new buildings and to increasing consumption by individual consumers. There were eight gas-making stations, of which three were very small, while only two were connected together effectively. Most distributing mains laid prior to the advent of the South Eastern Gas Corporation in 1934-37 were of small diameter and many had become too small for the demands upon them. The Board was required to take decisions upon the future of the local stations, adequacy of storage, and provision of a distributing system capable of meeting all obligations.

Grid Costs

In his paper, the author continued, it had been shown that a grid system of great capacity could be constructed at a capital cost the burden of which was relatively slight to the consumer, and which enabled the Board to sell gas more cheaply by supplying gas made in the most favourably placed stations rather than to manufacture requirements locally where the only advantage might be that associated with the production of coke.

The ways in which estimations were made of the quantities of gas likely to be required 20 or 30 years hence in the various boroughs and parishes had been stated, and they depended chiefly upon planned or expected movements of, and changes in, population, the migration of industry, and the tendency to increased consumption of gas per consumer. The last part of the paper recounted some of the technical problems associated with the distribution plans, and the methods by which these had been overcome. First, the automatic control of gasholder stations without the use of any form of outside power supply, which had been developed for two-holder sites and might be suitable for more complicated conditions. There followed descriptions of two above-stream river crossings, both unusual on account of engineering difficulties; the former also because of its magnitude. Lastly were described river and rail crossings in over-bridges that involved topographical alterations as well as the use of special tubes.

Closing Stages

A vote of thanks to all who had done so much to make the meeting such a success was proposed by Colonel W. M. Carr. The vote covered the representatives from overseas, the Institution of Civil Engineers, the North Thames and the South Eastern Gas Boards, McVitie and Price, Ltd., Briggs Motor Bodies, Ltd., the Zoological Society, the House Manager of the Royal Festival Hall, the Founder of the Glynebourne Festival, the authors of papers, the scrutineers of the ballots, the officers, auditors, council, and committees of the Institution, and finally the Institution Secretary and staff. Colonel Carr said that, perhaps by reason of his years, he appreciated fully the work behind the scenes carried out by the scrutineers of the ballots and the officers of the Institution. That work, going on all the year round, not receiving very much publicity and often, he felt, not accorded the recognition that it ought to be given, was something for which they must at all times be grateful. Study of the annual report of the Institution, while it was brief in form, gave some indication of the great amount of work that had been done. Their thanks were certainly due to those who had been responsible. He would also express their thanks to their indefatigable Secretary, Dr. Braunholtz, and the staff of the Institution. Year by year one was almost inclined to take as a matter of course the wonderful organisation of the annual meeting; but it was typical of Dr. Braunholtz, with his thoroughness and his energy, that everything should go without a hitch. He knew that he was expressing what they all felt when he thanked him for his work.

Mr. Frederick Wilson, who seconded the vote, said he was sure that the 88th annual meeting of the Institution had upheld and enhanced the great tradition of past years. Colonel Carr has spoken of the Secretary and staff, of whom no praise was too high. Their aim is our comfort and pleasure. Dr. Braunholtz was more than a Secretary. He was indeed a friend and kindly adviser to all who sought his aid.

G.J. 3435

W. Macnaughton (Wolverhampton), second from left, with W. Dawes, D. N. Hutton and S. Francis, all of Woodall-Duckham.

The President: We have with us Colonel H. C. Smith. As he is one of our honorary auditors I ask him to reply.

Colonel Smith remarked that Mr. Birks did not often make a mistake, but he has erred on that occasion. He (the speaker) was not one of the

honorary auditors. He was the honorary auditor. What the President had done was to give him an opportunity of expressing his gratitude to the Council and to the members of this Institution for electing him an honorary member. He appreciated the honour most sincerely. They all liked to belong to a 'good show,' and he was proud indeed of having been elected an honorary member of this very good show, the Institution of Gas Engineers. It had had a great history, it had performed great services to the gas industry, and he was convinced that it was going to perform still greater services in the future. He had always been proud to be a member. He was prouder still to be an honorary member.

G.J. 3444

Francis Drake (Drakes, Ltd.), C. P. Bateman (Bath), Norman Smith (Smith Meters, Ltd.), and W. J. Baker (Weston-super-Mare).

Year of Excellent Vintage

Mr. J. H. Dyde (President-Elect) then proposed a vote of thanks to Mr. Birks, after which he presented him with the Certificate of his office as President of the Institution. There might have been reasons, said Mr. Dyde, why one who, as a brilliant engineer and with those qualities so eminently suited to a president, should not have held the office before, but, after all, he thought it was kindly fate that sent him to serve the Institution at a time when the industry was in a state of transition, when sober thinking, tact, and a firm but kindly hand were needed to guide it in the right direction. During his years as Vice-President and President of the Institution, Mr. Birks had made many new friends throughout the country, but those of them who had had the honour to serve on the Council perhaps knew him best as a wise counsellor, never ruffled, with a sense of humour that on more than one occasion had resolved a contentious argument and brought the meeting back to earth and to the point at issue. This ability to grasp the point that really mattered was a rare faculty, and Mr. Birks had it in abundance. With modesty always, he had pushed forward, never seeking the limelight himself; but, in point of fact, no bushel could hide the light of his brilliance. His presidential address, the very high standard of the year's technical contributions which had been presented to the Institution, the great value of the technical reports which had been disseminated throughout the industry—all had combined to give them a year of excellent vintage, a vintage which was not only a contribution to the Festival of 1951, but which would be an outstanding record in the annals of the Institution.

G.J. 3481

L. S. Crowle (North Cheshire), second from left, with F. Litler, A. Henshall (Deputy Chairman), W. Hodkinson, and W. H. B. Porter, all of the North Western Gas Board.

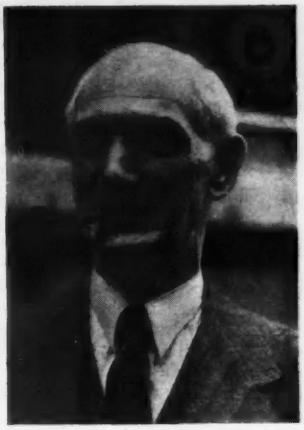
Encouragement of Juniors

The vote was seconded by Mr. J. C. Hogg, who as one of the more junior members of the Institution, said how glad he was to have an opportunity of voicing their thanks to the President for what he had done for the younger members during the year. He became aware at an early age of Mr. Birks' interest in the junior members, and this year had borne out that point, for he had encouraged the junior associations to continue and maintain their identity and activities and yet keep in close association with the Institution. He had enabled a succession of papers and reports to appear of a standard which would be of considerable value to those who were studying for courses of the higher standard now in being. Mr. Birks had shown a direct interest in the activities of the juniors. For example, he had found time to address the Manchester Juniors, and as one of the members of that Association he knew how much Mr. Birks' visit and address were appreciated.

The New President and Vice-Presidents

J. H. DYDE, M.SC., President of the Institution, 1951-52.

G. E. CURRIER, O.B.E., Senior Vice-President.



J. T. HAYNES, Junior Vice-President.

THE 1950 INSTITUTION MEDALLISTS

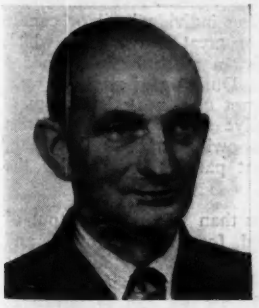
The H. E. Jones Medal, 1950, was awarded to H. Stanier, M.A., F.R.I.C., and J. B. McKean, B.SC., A.R.I.C., A.M.I.CHEM.E., for their joint paper on the production of town gas by the catalytic gasification of petroleum oils, presented at the autumn research meeting of the Institution in November last. Mr. Stanier is Chief Chemist and Mr. McKean Chemical Engineer at the Central Laboratories of the South Eastern Gas Board, and it may be recalled that in their paper they foreshadowed the possibility, in simple plant of producing at least 1.25 therms per gallon (300 therms per ton) of 500 B.Th.U. gas having characteristics similar to those of normal town gas, using as raw material heavy petroleum fractions. It was computed that it should be possible when working on full load to produce oil gas at a price competitive with that of base load coal gas. Not only may the process considerably reduce the cost of supplying peak load gas but it may also provide an alternative to gas manufactured from coal, particularly where the transport of coal and coke makes these fuels costly.

H. STANIER, M.A.

J. B. MCKEAN, B.SC.

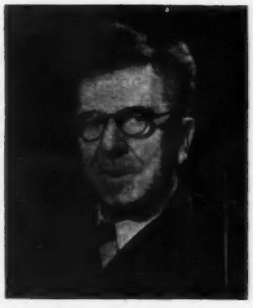
S. K. HAWTHORN.

The Institution Silver Medal, 1950, went to S. K. Hawthorn, Engineer of the Birmingham and District Division of the West Midlands Gas Board. The award was for a paper to the Midland Association (now a District Section of the Institution) concerning the efficient use of existing gas-making plant and planning extensions with maximum economy. Mr. Hawthorn joined the Birmingham undertaking in 1918. His career as a gas engineer started as retort house superintendent at Windsor Street followed by service as technical assistant to the engineer-in-chief. He holds a first-class Diploma (Manufacture) of the Institution and was awarded the Institution Bronze Medal in 1931.



F. E. MILLS, B.SC.

For their joint paper on carbon monoxide given to the London and Southern Junior Gas Association, F. E. Mills, B.SC., and F. C. Smith were awarded the Institution Bronze Medal. Both authors are at Watson House, North Thames Gas Board. The paper which won the award brought out the supreme importance of ventilation—the need to ensure the proper disposal and evacuation of the products of combustion.



F. C. SMITH.

Tariffs and the Peak Load

Mr. F. M. Birks' Presidential Address*

THE Institution during the past year has been adjusting itself to fit in with the new structure of the industry and it is pleasant to record an increase in membership of 7%.

The Gas Council has most generously appreciated the work of the Institution, in regard both to education and to codes of safe practice, as well as delegating to us the task of investigating complex technical problems for solution and report, which is very gratifying. Procedure has been agreed so that panels of specialists can be called together at short notice to deal with each matter as it arises. The formation of technical committees and panels of the Institution is only possible with the cordial and sympathetic assistance of the area boards, who allow many busy members of their staffs freely to give both time and energy in this cause. Thus has been forged a workmanlike link between the industry and the Institution. The Gas Council has recognised the financial burden thrown upon us and supports us to such an extent that today, of professional Institutions of similar size, ours is probably in the most favourable position of any in the country.

The Institution is now going from strength to strength, being much assisted by the conversion in the past year of several District Associations into Sections of the Institution. This will enable members all over the country to take a more intimate and active part in the proceedings and other work of the Institution than was previously possible for those living far from the Metropolis. Nothing but good can come from this extension of activities, and our thanks are due to all those who have so long and earnestly worked to bring it about. The achievement was only possible because the members of the District Section in all parts gave such loyal help to the Institution and their Associations, and took a sympathetic, sane and practical view of the matter. We (all the members) can congratulate ourselves, and I personally wish to record the pleasant experience of attending several of the Sections' meetings and finding them full of enthusiasm and an enhanced sense of responsibility.

In saying how valuable is the work done on education for the industry in the past, the present, and, we sincerely believe, the future, I cannot pass on without paying a tribute to our dear old Honorary Secretary, John Terrace. He has worked for years towards this great end, and recently, on his retirement from the chair of the Gas Education Committee, those who were closely associated with him presented to him a tribute of their esteem and affection in a little personal gift. Moreover as a permanent memorial to his work a silver cigarette box suitably inscribed has been presented to the Council for use on official occasions. I am sure you will join me in wishing John Terrace health and happiness.

The Scientific Basis

A year or two ago a prominent scientist gave a most intriguing lecture to the Royal Institution on the structure of birds, pointing out that it followed in every respect correct engineering practice. Birds have little more intelligence than reptiles, and it is a somewhat sobering thought that they have achieved perfect results even allowing for the several million years they have taken in the process. Many other cases could be quoted, particularly those of creatures that have been adapting themselves to some specialised form of existence, such as certain marine mammals which have reached a point, with the materials at their disposal, that no form of engineering could better, except with the addition of outside power. Here we see the principle on which is based the legend that a monkey scribbling on a piece of paper would write sonnets of Shakespeare if given infinite time; and time is the great factor, as it is in all our engineering calculations. May it not well be that all problems follow natural laws which if given sufficient time must prevail, but in the meanwhile our efforts to solve problems quickly lead us not infrequently up paths that have dead ends? You may wonder what bearing this has on the gas industry, but I want to start with first principles and shall refer again to certain fundamental engineering laws that may prove to be pointers in a direction we can follow with advantage. That the function of a trained engineer is to arrive at a correct solution of a problem in a fraction of the time required by untrained groping, postulates that the solution shall be not only correct physically, but also economically. Engineers are, therefore, inevitably bound up with the costs of their work.

Our great difficulties today are due to the monetary inflation we have experienced during the last decade, which has been further increased by shortages of materials for gas production as well as for plant construction. There is also another shortage, and that is of time, in so far that all new work consumes too much precious time while under construction.

Difficulties or no difficulties, we have to go ahead and to many the added difficulties give an added interest to our work. The rapid changes that occur demand more flexible thinking and may well be a blessing inasmuch as they ensure that we do not become too set in our ways.

Some Comparisons

During my term of office there have been published the first report and accounts of the Gas Council and the second report and accounts of the British Electricity Authority, covering almost the same period. They are available from His Majesty's Stationery Office for a few shillings and everyone in the industry would be well advised to study both carefully side by side.

Both industries provide vital public services, but no direct overall comparison can be made between them since one supplies energy in the form of electric current and the other a fuel in the form of gas, both services of which are quasi-monopolistic, and the gas industry also sells its by-products in open markets abroad and partially controlled markets at home. It is, however, possible to make a comparison between them, with a very fair degree of accuracy, provided always that it is related solely to one specific common application of their use. Moreover, the picture can be much more clearly drawn, particularly to the non-technical person, if it is expressed not as a notional percentage of efficiency, but in terms of demand on the nation's resources.

Both industries were built up to provide a form of lighting that eliminated the work of tending individual oil or candle lights, thus supplying a service of great convenience which at the same time was able to give a much higher standard of illumination at a lower cost. During the war we were used to the blackout, but it was not until recently that most people had any idea of the relative sources of public street lighting in the Metropolis, when owing to difficult circumstances caused by a strike a great part of London had the gas lighting blacked out.

It is of interest to note that less than 1% of the output of the electrical industry is supplied for public lighting, and only 2.3% of the output of the gas industry is supplied for that purpose. Nevertheless, it would appear that it behoves us to consider very carefully whether we can in justice to other consumers continue only to obtain for public lighting

* Abstract of I.G.E. Communication No. 382.

a return of 63% of the average price per therm of gas sold while our sister service obtains a return equal to the average return per unit of electricity.

While on the subject of lighting, some consideration of the type of load it represents may be of interest. Personally, I hold the view that a knowledge of historical considerations is always useful, so I have spent some time and energy in obtaining information as to the past conditions of our industry. It is most informative to find that the former Gas Light and Coke Company, during the early years of the century, did not have to install any gasholders for some 33 years, when the change of consumption from lighting to heating set in, which is the more remarkable as over the same period the consumption grew by over 60%. It is not generally appreciated what a large capacity of holders was required to meet the massive impact on consumption that the 'pea soup' fogs of the latter end of the 19th century had on the then high-percentage lighting load by extending drastically the hours of usage. Persons like myself have watched through this century the gradual emergence of London from a coating of funereal black to the sparkling beauty of its old buildings now restored to their original appearance, thanks mainly to the efficiency of both our own and the electrical industry in the cleaning of the air. Here I would like to pay tribute to our Cinderella, because it is possible that the solid fuel industry might not have so energetically prosecuted the search after more efficient household grates had not devoted workers in our own industry been so successful in leading the way to the efficient utilisation of coke.

Fuel Economies for Cooking

The cooking load has steadily grown for the last half century, but it may not be generally understood how economically suitable it is for our particular service, although most housewives appreciate the great qualities of gas for the purpose. The daily load factor of less than 30% is not a good one, consisting as it does of three peaks during the day, but, because of the simple and effective means of storage we have at our command, it is possible for the industry to operate efficiently in meeting this consumption. The cost of holders is low enough to enable the week-end changes of consumption from this source to be met relatively cheaply. There is little or no seasonal variation of load due to cooking, so that the yearly load factor on the production plant is exceptionally good. In short, the housewife with her cooker is our best customer. This subject deserves such consideration that I must go more deeply into it.

Taking the gas and electricity industries, it is difficult to dissociate one load from another in either industry with a great degree of accuracy, but a perspective view can be obtained by assuming that both industries are engaged solely on one specific service. For this purpose, and this purpose only, I am using the factor of 20 units of electricity as equivalent to one therm of gas, which factor takes into account any difference in the efficiency of the cooking appliance. On this basis it will be found that the total outputs of both industries are so close that no correction is really necessary. It is, of course, obvious that the two industries could not both be fully engaged on cooking, even supposing that there existed a sufficiency of the materials required by Mrs. Beeton. The gas industry is credited with using some 23 mill. tons of coal a year, as well as a considerable quantity of oil. The use of oil at the present moment is heavier than in normal years in order to conserve for the time being the coal resources of the country, but it is a simple matter to calculate the extra coal that would need to be substituted for this raw material. If the gas that the industry itself makes were made solely from coal, then more than 23 mill. tons of coal would be required, but on the other hand, apart from the gas it sells, the industry also sells a great deal of fuel as coke and liquid products, which if not available from this source would have to be supplied to the community in the form of coal. A simple analysis shows that the coal substance converted by the gas industry into town gas is just about 15 mill. tons per annum. This is the figure we should use for our comparison, and it is of great significance that if both industries supplied their main product for cooking only then the consumption of coal would be in the ratio of 15 mill. tons for gas to 30 mill. tons for electricity.

In both industries the capital cost behind the cooking appliance is considerable—that is, in the necessity of providing the appropriate gasworks plant or generating capacity—but it can be shown that between two and three times the amount of capital is required to supply the current to an electric cooker as is needed to furnish the gas for a gas cooker. It may well be asked, then, why should not the cost of cooking by electricity be twice that of cooking by gas? Until now it has been extremely difficult to answer this question because of the multiplicity of tariffs offered by both industries, so that it was always possible to quote special cases in proof of the argument in either direction. It is therefore illuminating to find from the published accounts that the average cost of gas in the country for the period under review is 12.55d. per therm, while the average price of electric current is 1.21d. per B.o.T. unit, which for the purpose of cooking only is equivalent to 24.2d. per therm, or nearly twice as much.

Tariffs

In the early years of the century I regularly read the publications of the Electrical Press and remember being fascinated with articles and correspondence on the subject of the two-part tariff. In order to refresh my memory I recently turned up several volumes of that period and found that these tariffs were then based mainly on maximum demand. At that time it was assumed that there was a scientific basis for such a tariff, and even today this appears to be accepted as an axiom by many engineers and others.

In its inception the two-part tariff had something to commend it, for it endeavoured to separate the capital charges from the operating costs by measuring the maxium demand as well as the total units consumed. It would not, however, anticipate potential maximum demand, and herein lay a weakness. In later years efforts were made to apply this system to small-scale users, and as it was not practical to provide a maximum demand meter for each consumer, all kinds of methods of estimating the maximum demand were evolved, including such illogical bases as ratable values of premises, floor areas, or numbers of rooms. In my opinion it was at this point that the whole structure of two-part tariffs broke down, with the result that tariffs were adjusted in the interests of promotional sales rather than correct economics. It is, therefore, not surprising to find from a study of present-day returns for revenue received from different classes of consumers that some users are receiving favourable terms at the expense of others, and further that the charges are generally heaviest where the monopoly is strongest. The last half century has produced several hundred different two-part tariffs based on all and sundry, of which all cannot be either scientific or equitable. Well realising this, I was not so shocked as I might otherwise have been when a month or so ago a friend quite seriously suggested to me that there should only be a flat tariff in each area for all consumers in both industries. The suggestion was put forward purely on a political basis, but on thinking it over it does appear that a more logical and scientific solution to the problem might possibly lie in that direction, and it might well be worthy of careful consideration.

In discussing matters such as this with friends, I find that the subject of diversity is one that occupies many people's thoughts. In every direction loads are being sought and are being suggested that will improve the normal load factor, and, further, it is often suggested that tariffs should be adjusted in such a manner that loads that can be supplied when plant is otherwise idle can be taken at a reduced rate. Now, there is seldom any relationship between one load and another, so that there is no means of ensuring that any load obtained at a reduced rate will in fact stop at the point where it gives maximum improvement in the load factor. When it arrives at this point and then continues and even gains momentum because of its low price, it will progressively

Carbonising plant comprising 3,500 retorts set in 25 retort benches, entailed a regular succession of plant renewal in which amendments in plant design had been progressively incorporated. This identity of interest between design and process was an over-riding factor in technical progress. This close relationship and the consequent continual spur to development of design, demanded the definition and evaluation of the materials of plant construction. This involved the adoption of a system of specification and inspection set up to cover all aspects of fabrication and construction and of material supply.

G. J. 3434

T. C. Whimster, W. L. Hurdman, and R. J. Rogers, all of the Parkinson Stove Company.

Distribution in North Thames

The final paper of the meeting was by Mr. A. B. L. Copp, North Thames Gas Board, and dealt with the distribution development in the western area of the Board. On vesting day, 1949, the Board acquired the assets of the Gas Light and Coke Company and 11 other undertakings. Of these, five adjoined each other at the western end of the Board's area, and each possessed manufacturing stations except the Chertsey undertaking; the Slough, Windsor, and Ascot companies had one each, while the Uxbridge company possessed works at Uxbridge, Amersham, High Wycombe, Marlow, and Maidenhead, and took bulk supplies from both the Gas Light and Coke Company and the Watford and St. Albans company. Most of the areas of these five undertakings are developing at a rapid rate, and the future of their supplies after vesting day had to be determined at a very early date. The distribution systems existing had been built up over about 100 years on the basis of no co-ordination and were barely able to meet the demand for gas. In order that all aspects of a main-laying programme sufficient to fulfil requirements for the next 30 or 40 years could be considered, it was necessary to examine all features of development—that proceeding, that probable or planned, and that which appeared reasonably possible. An estimation of the demand to be expected from each individual parish was made.

Economies of Riverside Stations

It was thought that it would prove more economical to make gas at the large riverside Gas Light stations of the Board than further to extend those of the absorbed companies in the west, and in order to arrive at a cost of gas delivered throughout the area in question, a grid system was devised, and estimates made of the cost. In the paper the economics of bulk supply were summed up and figures given of cost for manufacture and transmission of gas from large riverside stations through the existing and proposed grid systems, and also a figure equivalent to the cost of transporting coke for local sale. A note was added drawing attention to the differences between conditions of supply in the western and eastern areas of the Board. The execution of works involving the laying of gas mains of large diameter is often beset with engineering difficulties. Some of these have already been encountered, and those that appear to be of general interest were described and illustrated in the paper. Appendices were added in which statistics were presented of gas storage capacities and of inclusive costs of manufacture and transmission.

Introducing his paper, Mr. Copp remarked that nationalisation of the gas industry, and the formation of area boards in 1949 greatly accelerated the slow progress that was being made in various forms of amalgamation and integration, which linked up one undertaking with another. The statutory charge 'to develop and maintain an efficient, co-ordinated and economical system of gas supply for their area and to satisfy, so far as it is economical to do so, all reasonable demands for gas within their area,' had been taken up with enthusiasm by all the boards. This necessarily required that a thorough examination be made of the economics of giving bulk supplies from those manufacturing stations able to supply cheap gas to those in a less advantageous position, and the planning of suitable mains and storage stations so that the adequate supplies called for might be available.

Each gas board, he continued, possessed individuality, and diversity of conditions within the areas of the various boards made comparison between their methods and results difficult to apply for arriving at approved policies giving optimum advantages. The North Thames Gas Board was peculiar not only because it sold an enormous quantity of products in a very small area, but because it included the former Gas Light and Coke Company. Such was the vast size of that Company that it represented nearly nine-tenths of the Board's present business. It possessed many efficient manufacturing stations and a grid distributing system of great capacity linking the stations together, carrying gas to holder stations, and, through 100 underground district governors, assisting to give consumers a constant supply free from notable variations in pressure.

The former Gas Light and Coke Company in its long history had already absorbed close on 50 original undertakings; it had, therefore, experience and traditions that gave smooth continuity in implementing

the Gas Act of 1949; and there was the fortunate continuity of direction which was preserved. Integration of those former undertakings that supplied the built-up metropolitan area was clearly the proper policy to pursue, and as each had a well developed and comparatively adequate distributing system all that was required was to lay mains connecting the various gasworks with the nearest effective point of the 'Gas Light' grid. The western end of the Board's area, however, was entirely different in characteristics from any other part. Although largely rural, it nevertheless contained some considerable towns, of which three may be termed industrial—*viz.*, Slough, Uxbridge, and High Wycombe. The consumption of gas was increasing steadily at a rate exceeding 5% per annum, due both to new buildings and to increasing consumption by individual consumers. There were eight gas-making stations, of which three were very small, while only two were connected together effectively. Most distributing mains laid prior to the advent of the South Eastern Gas Corporation in 1934-37 were of small diameter and many had become too small for the demands upon them. The Board was required to take decisions upon the future of the local stations, adequacy of storage, and provision of a distributing system capable of meeting all obligations.

Grid Costs

In his paper, the author continued, it had been shown that a grid system of great capacity could be constructed at a capital cost the burden of which was relatively slight to the consumer, and which enabled the Board to sell gas more cheaply by supplying gas made in the most favourably placed stations rather than to manufacture requirements locally where the only advantage might be that associated with the production of coke.

The ways in which estimations were made of the quantities of gas likely to be required 20 or 30 years hence in the various boroughs and parishes had been stated, and they depended chiefly upon planned or expected movements of, and changes in, population, the migration of industry, and the tendency to increased consumption of gas per consumer. The last part of the paper recounted some of the technical problems associated with the distribution plans, and the methods by which these had been overcome. First, the automatic control of gasholder stations without the use of any form of outside power supply, which had been developed for two-holder sites and might be suitable for more complicated conditions. There followed descriptions of two above-stream river crossings, both unusual on account of engineering difficulties; the former also because of its magnitude. Lastly were described river and rail crossings in over-bridges that involved topographical alterations as well as the use of special tubes.

Closing Stages

A vote of thanks to all who had done so much to make the meeting such a success was proposed by Colonel W. M. Carr. The vote covered the representatives from overseas, the Institution of Civil Engineers, the North Thames and the South Eastern Gas Boards, McVitie and Price, Ltd., Briggs Motor Bodies, Ltd., the Zoological Society, the House Manager of the Royal Festival Hall, the Founder of the Glynebourne Festival, the authors of papers, the scrutineers of the ballots, the officers, auditors, council, and committees of the Institution, and finally the Institution Secretary and staff. Colonel Carr said that, perhaps by reason of his years, he appreciated fully the work behind the scenes carried out by the scrutineers of the ballots and the officers of the Institution. That work, going on all the year round, not receiving very much publicity and often, he felt, not accorded the recognition that it ought to be given, was something for which they must at all times be grateful. Study of the annual report of the Institution, while it was brief in form, gave some indication of the great amount of work that had been done. Their thanks were certainly due to those who had been responsible. He would also express their thanks to their indefatigable Secretary, Dr. Braunholtz, and the staff of the Institution. Year by year one was almost inclined to take as a matter of course the wonderful organisation of the annual meeting; but it was typical of Dr. Braunholtz, with his thoroughness and his energy, that everything should go without a hitch. He knew that he was expressing what they all felt when he thanked him for his work.

Mr. Frederick Wilson, who seconded the vote, said he was sure that the 88th annual meeting of the Institution had upheld and enhanced the great tradition of past years. Colonel Carr has spoken of the Secretary and staff, of whom no praise was too high. Their aim is our comfort and pleasure. Dr. Braunholtz was more than a Secretary. He was indeed a friend and kindly adviser to all who sought his aid.

The President: We have with us Colonel H. C. Smith. As he is one of our honorary auditors I ask him to reply.

Colonel Smith remarked that Mr. Birks did not often make a mistake, but he has erred on that occasion. He (the speaker) was not one of the

G.J. 3435

W. Macnaughton (Wolverhampton), second from left, with W. Dawes, D. N. Hutton and S. Francis, all of Woodall-Duckham.

honorary auditors. He was the honorary auditor. What the President had done was to give him an opportunity of expressing his gratitude to the Council and to the members of this Institution for electing him an honorary member. He appreciated the honour most sincerely. They all liked to belong to a 'good show,' and he was proud indeed of having been elected an honorary member of this very good show, the Institution of Gas Engineers. It had had a great history, it had performed great services to the gas industry, and he was convinced that it was going to perform still greater services in the future. He had always been proud to be a member. He was prouder still to be an honorary member.

G.J. 3444

Francis Drake (Drakes, Ltd.), C. P. Bateman (Bath), Norman Smith (Smith Meters, Ltd.), and W. J. Baker (Weston-super-Mare).

Year of Excellent Vintage

Mr. J. H. Dyde (President-Elect) then proposed a vote of thanks to Mr. Birks, after which he presented him with the Certificate of his office as President of the Institution. There might have been reasons, said Mr. Dyde, why one who, as a brilliant engineer and with those qualities so eminently suited to a president, should not have held the office before, but, after all, he thought it was kindly fate that sent him to serve the Institution at a time when the industry was in a state of transition, when sober thinking, tact, and a firm but kindly hand were needed to guide it in the right direction. During his years as Vice-President and President of the Institution, Mr. Birks had made many new friends throughout the country, but those of them who had had the honour to serve on the Council perhaps knew him best as a wise counsellor, never ruffled, with a sense of humour that on more than one occasion had resolved a contentious argument and brought the meeting back to earth and to the point at issue. This ability to grasp the point that really mattered was a rare faculty, and Mr. Birks had it in abundance. With modesty always, he had pushed forward, never seeking the limelight himself; but, in point of fact, no bushel could hide the light of his brilliance. His presidential address, the very high standard of the year's technical contributions which had been presented to the Institution, the great value of the technical reports which had been disseminated throughout the industry—all had combined to give them a year of excellent vintage, a vintage which was not only a contribution to the Festival of 1951, but which would be an outstanding record in the annals of the Institution.

G.J. 3481

L. S. Crowle (North Cheshire), second from left, with F. Litler, A. Henshall (Deputy Chairman), W. Hodkinson, and W. H. B. Porter, all of the North Western Gas Board.

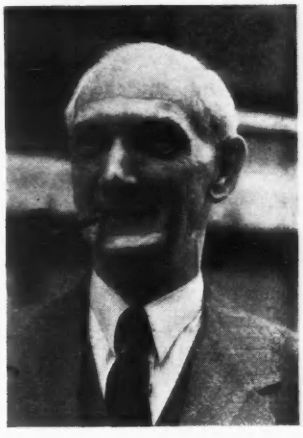
Encouragement of Juniors

The vote was seconded by Mr. J. C. Hogg, who as one of the more junior members of the Institution, said how glad he was to have an opportunity of voicing their thanks to the President for what he had done for the younger members during the year. He became aware at an early age of Mr. Birks' interest in the junior members, and this year had borne out that point, for he had encouraged the junior associations to continue and maintain their identity and activities and yet keep in close association with the Institution. He had enabled a succession of papers and reports to appear of a standard which would be of considerable value to those who were studying for courses of the higher standard now in being. Mr. Birks had shown a direct interest in the activities of the juniors. For example, he had found time to address the Manchester Juniors, and as one of the members of that Association he knew how much Mr. Birks' visit and address were appreciated.

The New President and Vice-Presidents

J. H. DYDE, M.SC., President of the Institution, 1951-52.

G. E. CURRIER, O.B.E., Senior Vice-President.

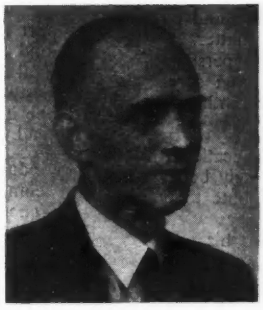


J. T. HAYNES, Junior Vice-President.

THE 1950 INSTITUTION MEDALLISTS

The H. E. Jones Medal, 1950, was awarded to H. Stanier, M.A., F.R.I.C., and J. B. McKean, B.SC., A.R.I.C., A.M.I.CHEM.E., for their joint paper on the production of town gas by the catalytic gasification of petroleum oils, presented at the autumn research meeting of the Institution in November last. Mr. Stanier is Chief Chemist and Mr. McKean Chemical Engineer at the Central Laboratories of the South Eastern Gas Board, and it may be recalled that in their paper they foreshadowed the possibility, in simple plant of producing at least 1.25 therms per gallon (300 therms per ton) of 500 B.Th.U. gas having characteristics similar to those of normal town gas, using as raw material heavy petroleum fractions. It was computed that it should be possible when working on full load to produce oil gas at a price competitive with that of base load coal gas. Not only may the process considerably reduce the cost of supplying peak load gas but it may also provide an alternative to gas manufactured from coal, particularly where the transport of coal and coke makes these fuels costly.

H. STANIER, M.A.



J. B. MCKEAN, B.SC.

S. K. HAWTHORN.

The Institution Silver Medal, 1950, went to S. K. Hawthorn, Engineer of the Birmingham and District Division of the West Midlands Gas Board. The award was for a paper to the Midland Association (now a District Section of the Institution) concerning the efficient use of existing gas-making plant and planning extensions with maximum economy. Mr. Hawthorn joined the Birmingham undertaking in 1918. His career as a gas engineer started as retort house superintendent at Windsor Street followed by service as technical assistant to the engineer-in-chief. He holds a first-class Diploma (Manufacture) of the Institution and was awarded the Institution Bronze Medal in 1931.

F. E. MILLS, B.SC.

For their joint paper on carbon monoxide given to the London and Southern Junior Gas Association, F. E. Mills, B.SC., and F. C. Smith were awarded the Institution Bronze Medal. Both authors are at Watson House, North Thames Gas Board. The paper which won the award brought out the supreme importance of ventilation—the need to ensure the proper disposal and evacuation of the products of combustion.

F. C. SMITH.

Tariffs and the Peak Load

Mr. F. M. Birks' Presidential Address*

THE Institution during the past year has been adjusting itself to fit in with the new structure of the industry and it is pleasant to record an increase in membership of 7%.

The Gas Council has most generously appreciated the work of the Institution, in regard both to education and to codes of safe practice, as well as delegating to us the task of investigating complex technical problems for solution and report, which is very gratifying. Procedure has been agreed so that panels of specialists can be called together at short notice to deal with each matter as it arises. The formation of technical committees and panels of the Institution is only possible with the cordial and sympathetic assistance of the area boards, who allow many busy members of their staffs freely to give both time and energy in this cause. Thus has been forged a workmanlike link between the industry and the Institution. The Gas Council has recognised the financial burden thrown upon us and supports us to such an extent that today, of professional Institutions of similar size, ours is probably in the most favourable position of any in the country.

The Institution is now going from strength to strength, being much assisted by the conversion in the past year of several District Associations into Sections of the Institution. This will enable members all over the country to take a more intimate and active part in the proceedings and other work of the Institution than was previously possible for those living far from the Metropolis. Nothing but good can come from this extension of activities, and our thanks are due to all those who have so long and earnestly worked to bring it about. The achievement was only possible because the members of the District Section in all parts gave such loyal help to the Institution and their Associations, and took a sympathetic, sane and practical view of the matter. We (all the members) can congratulate ourselves, and I personally wish to record the pleasant experience of attending several of the Sections' meetings and finding them full of enthusiasm and an enhanced sense of responsibility.

In saying how valuable is the work done on education for the industry in the past, the present, and, we sincerely believe, the future, I cannot pass on without paying a tribute to our dear old Honorary Secretary, John Terrace. He has worked for years towards this great end, and recently, on his retirement from the chair of the Gas Education Committee, those who were closely associated with him presented to him a tribute of their esteem and affection in a little personal gift. Moreover as a permanent memorial to his work a silver cigarette box suitably inscribed has been presented to the Council for use on official occasions. I am sure you will join me in wishing John Terrace health and happiness.

The Scientific Basis

A year or two ago a prominent scientist gave a most intriguing lecture to the Royal Institution on the structure of birds, pointing out that it followed in every respect correct engineering practice. Birds have little more intelligence than reptiles, and it is a somewhat sobering thought that they have achieved perfect results even allowing for the several million years they have taken in the process. Many other cases could be quoted, particularly those of creatures that have been adapting themselves to some specialised form of existence, such as certain marine mammals which have reached a point, with the materials at their disposal, that no form of engineering could better, except with the addition of outside power. Here we see the principle on which is based the legend that a monkey scribbling on a piece of paper would write sonnets of Shakespeare if given infinite time; and time is the great factor, as it is in all our engineering calculations. May it not well be that all problems follow natural laws which if given sufficient time must prevail, but in the meanwhile our efforts to solve problems quickly lead us not infrequently up paths that have dead ends? You may wonder what bearing this has on the gas industry, but I want to start with first principles and shall refer again to certain fundamental engineering laws that may prove to be pointers in a direction we can follow with advantage. That the function of a trained engineer is to arrive at a correct solution of a problem in a fraction of the time required by untrained groping, postulates that the solution shall be not only correct physically, but also economically. Engineers are, therefore, inevitably bound up with the costs of their work.

Our great difficulties today are due to the monetary inflation we have experienced during the last decade, which has been further increased by shortages of materials for gas production as well as for plant construction. There is also another shortage, and that is of time, in so far that all new work consumes too much precious time while under construction.

Difficulties or no difficulties, we have to go ahead and to many the added difficulties give an added interest to our work. The rapid changes that occur demand more flexible thinking and may well be a blessing inasmuch as they ensure that we do not become too set in our ways.

Some Comparisons

During my term of office there have been published the first report and accounts of the Gas Council and the second report and accounts of the British Electricity Authority, covering almost the same period. They are available from His Majesty's Stationery Office for a few shillings and everyone in the industry would be well advised to study both carefully side by side.

Both industries provide vital public services, but no direct overall comparison can be made between them since one supplies energy in the form of electric current and the other a fuel in the form of gas, both services of which are quasi-monopolistic, and the gas industry also sells its by-products in open markets abroad and partially controlled markets at home. It is, however, possible to make a comparison between them, with a very fair degree of accuracy, provided always that it is related solely to one specific common application of their use. Moreover, the picture can be much more clearly drawn, particularly to the non-technical person, if it is expressed not as a notional percentage of efficiency, but in terms of demand on the nation's resources.

Both industries were built up to provide a form of lighting that eliminated the work of tending individual oil or candle lights, thus supplying a service of great convenience which at the same time was able to give a much higher standard of illumination at a lower cost. During the war we were used to the blackout, but it was not until recently that most people had any idea of the relative sources of public street lighting in the Metropolis, when owing to difficult circumstances caused by a strike a great part of London had the gas lighting blacked out.

It is of interest to note that less than 1% of the output of the electrical industry is supplied for public lighting, and only 2.3% of the output of the gas industry is supplied for that purpose. Nevertheless, it would appear that it behoves us to consider very carefully whether we can in justice to other consumers continue only to obtain for public lighting

* Abstract of I.G.E. Communication No. 382.

a return of 63% of the average price per therm of gas sold while our sister service obtains a return equal to the average return per unit of electricity.

While on the subject of lighting, some consideration of the type of load it represents may be of interest. Personally, I hold the view that a knowledge of historical considerations is always useful, so I have spent some time and energy in obtaining information as to the past conditions of our industry. It is most informative to find that the former Gas Light and Coke Company, during the early years of the century, did not have to install any gasholders for some 33 years, when the change of consumption from lighting to heating set in, which is the more remarkable as over the same period the consumption grew by over 60%. It is not generally appreciated what a large capacity of holders was required to meet the massive impact on consumption that the 'pea soup' fogs of the latter end of the 19th century had on the then high-percentage lighting load by extending drastically the hours of usage. Persons like myself have watched through this century the gradual emergence of London from a coating of funereal black to the sparkling beauty of its old buildings now restored to their original appearance, thanks mainly to the efficiency of both our own and the electrical industry in the cleaning of the air. Here I would like to pay tribute to our Cinderella, because it is possible that the solid fuel industry might not have so energetically prosecuted the search after more efficient household grates had not devoted workers in our own industry been so successful in leading the way to the efficient utilisation of coke.

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In both industries the capital cost behind the cooking appliance is considerable—that is, in the necessity of providing the appropriate gasworks plant or generating capacity—but it can be shown that between two and three times the amount of capital is required to supply the current to an electric cooker as is needed to furnish the gas for a gas cooker. It may well be asked, then, why should not the cost of cooking by electricity be twice that of cooking by gas? Until now it has been extremely difficult to answer this question because of the multiplicity of tariffs offered by both industries, so that it was always possible to quote special cases in proof of the argument in either direction. It is therefore illuminating to find from the published accounts that the average cost of gas in the country for the period under review is 12.55d. per therm, while the average price of electric current is 1.21d. per B.o.T. unit, which for the purpose of cooking only is equivalent to 24.2d. per therm, or nearly twice as much.

Tariffs

In the early years of the century I regularly read the publications of the Electrical Press and remember being fascinated with articles and correspondence on the subject of the two-part tariff. In order to refresh my memory I recently turned up several volumes of that period and found that these tariffs were then based mainly on maximum demand. At that time it was assumed that there was a scientific basis for such a tariff, and even today this appears to be accepted as an axiom by many engineers and others.

In its inception the two-part tariff had something to commend it, for it endeavoured to separate the capital charges from the operating costs by measuring the maxium demand as well as the total units consumed. It would not, however, anticipate potential maximum demand, and herein lay a weakness. In later years efforts were made to apply this system to small-scale users, and as it was not practical to provide a maximum demand meter for each consumer, all kinds of methods of estimating the maximum demand were evolved, including such illogical bases as ratable values of premises, floor areas, or numbers of rooms. In my opinion it was at this point that the whole structure of two-part tariffs broke down, with the result that tariffs were adjusted in the interests of promotional sales rather than correct economics. It is, therefore, not surprising to find from a study of present-day returns for revenue received from different classes of consumers that some users are receiving favourable terms at the expense of others, and further that the charges are generally heaviest where the monopoly is strongest. The last half century has produced several hundred different two-part tariffs based on all and sundry, of which all cannot be either scientific or equitable. Well realising this, I was not so shocked as I might otherwise have been when a month or so ago a friend quite seriously suggested to me that there should only be a flat tariff in each area for all consumers in both industries. The suggestion was put forward purely on a political basis, but on thinking it over it does appear that a more logical and scientific solution to the problem might possibly lie in that direction, and it might well be worthy of careful consideration.

In discussing matters such as this with friends, I find that the subject of diversity is one that occupies many people's thoughts. In every direction loads are being sought and are being suggested that will improve the normal load factor, and, further, it is often suggested that tariffs should be adjusted in such a manner that loads that can be supplied when plant is otherwise idle can be taken at a reduced rate. Now, there is seldom any relationship between one load and another, so that there is no means of ensuring that any load obtained at a reduced rate will in fact stop at the point where it gives maximum improvement in the load factor. When it arrives at this point and then continues and even gains momentum because of its low price, it will progressively

reduce the load factor, and in the end the last position may be worse than the first.

It is my opinion that any advantages derived from diversity of load should be evenly distributed throughout the range of all consumers. Perhaps here I should quote the second law of motion, which states: 'To every action there is an equal and opposite reaction.' Loads built up on this law would always balance and could with safety be accepted up to any quantity without jeopardising the overall economics of the undertakings.

Continuing now with the two-part tariff, here again may I quote an engineering fundamental: 'All perfect prime movers must have a reversible cycle.' That the two-part tariff is promotional goes without saying, but the question is: What does it promote? This form of tariff started in the electricity industry long before it was introduced into the gas industry, and I venture to suggest that the fact that a phenomenal increase in output coincided with the development of this form of tariff in the electricity industry led many people to suppose that here was proof that the tariff was responsible for the success obtained. Such a supposition ignores the fundamental advantages and inherent soundness that ensured the very rapid development of the electricity industry. Had some more logical and scientific tariff been adopted, it might well have been that that industry would have been in just as powerful a position as it is today, and, what is more, it might have been healthier in so far that it might have been able always to meet its commitments during periods of peak consumption. Today, in quite different world conditions, we are being exhorted to economise so as to eke out our coal supplies, but it is now evident that a two-part tariff does not simulate a reversible cycle, and, therefore, those patriotic people who heed the governmental warnings do not at the same time reap a financial relief commensurate with their care and attention. Am I wrong in suggesting that all two-part tariffs are promotional only in regard to promoting waste?

Effect of Two-Part Tariff

What was the effect on the gas industry when in its turn it introduced the two-part tariff? The increase in annual consumption was not by any means spectacular, but in certain parts of the country the increase in peak load was a matter of great concern. This increase in consumption, far from decreasing the cost of gas manufacture, as its sponsors had predicted, had a reverse effect and tended to increase the overall cost. One appreciates that, however illogical and diverse tariffs may be, my friend's suggestion, even if considered to be correct, might prove too difficult to put into operation in the near future. On the other hand, it may be worthy of full consideration as the solution may lie in a gradual trend in this direction. Knowing full well the objections likely to be put forward, particularly the one that certain classes of consumer, who would have to pay more than at present, would for one reason or another be quite unable to do so, I have taken great interest in studying the accounts of both industries. Hitherto, I have talked of average returns for the industries as a whole, and if these may be taken as a datum line then it will be noted that the ratio between different classes of consumers varies considerably in different parts of the country; there may be a good reason for this, but it is not self evident. Further, with one or two exceptions, it can be found that in one area or another the average return for each class of consumer is greater than the average return for the whole country; there are some considerable and inexplicable differences in this respect. As I have indicated, the only class of consumer consistently well below the average in each area is public lighting by gas.

The load factor on public services must on the average be related to the load factor of human beings. Sleeping, working, eating, and amusing themselves, generally all at the same time, and requiring warmth for about half the year, unless they materially change their habits they give little hope of further considerable improvements in the load factor.

It will be found that there is an average load factor for each activity, which can be ascertained with a fair degree of accuracy if one is not led astray by too close a consideration of abnormal cases which occur seldom and which bear so little relation to the total loads as to be of no real significance.

Peak Load

From time to time I have had occasion to bring to your notice various economic factors in the production of gas, and in doing so have always stressed the influence of the peak load, which, incidentally, is greatest in the North Thames area. It follows that because this aspect is now more serious than ever, we have, in our area, been forced to study the problem somewhat in advance of our friends in other areas.

The setting out of the load factor on the single-line chart clearly shows that the amount of plant required always to meet the obligation is extremely large. In times like the present, when consumption outstrips the ability to install the additional plant needed to ensure that production will match demand, there are bound to be occasions when we fail to meet our commitments and, consequently, pressures have to be dropped. The single-line chart indicates the limits of the duration of periods over which deviations have to be made from normal gas pressures. As it is likely that many years may elapse before it will be possible to say with certainty that pressures on all occasions will remain normal, we have some time to consider the situation. Now that we have been forced by circumstances outside our control to cut down the output by pressure reductions, we may well begin to speculate whether or not it is in the interests of our consumers for the area to become completely safeguarded in this respect. There is a point where the introduction of additional plant on quite a large scale is an insurance that pressure is retained at normal merely for periods of one day or less, and it is necessary to balance up the loss and inconvenience caused by allowing a pressure drop for such a very short time against the inevitable increase in the overall cost of gas by the installation of so much costly plant. It may well be that in the course of a few years we shall accept the situation as normal.

As you may know, the proportion of carburetted water gas to coal gas in the North Thames area is higher than in most other areas, while the production of oil gas of a high specific gravity has also been introduced on a commercial scale; it follows that variations of specific gravity, with attendant variation in flame characteristics, are considerable. I have no hesitation in saying that I find it impossible to subscribe to the school of thought that advocates that the characteristics of the supply of town gas should remain constant at all times, quite apart from the fact that to make it so would take at least a decade, and involve the industry in very large and unjustifiable capital expenditure, with almost no compensating advantages. As I have said, there are periods, quite short, during which pressures may have to be lowered, and these periods will continue annually until such time as we are able to install additional plant at a rate that will overtake the growing consumption, and this may take several years. The effect of lowering pressures is simply to reduce the output, but in addition to lowering pressures we have for nearly half a century increased considerably at peak loads the specific gravity of the gas, which also has the effect of reducing the output so that there is a double check on the demand at peak load times, each factor taking its allotted share. I would point out that there was no predetermined policy towards this end during this period, but a process of evolving the cheapest and most expeditious means of meeting the occasional high demands with plant of low capital cost and high flexibility, which also could provide during the summer months a powerful corrective to a surplus of coke production. It follows that were it not for the increased specific gravity the pressure reductions for several years ahead would have to be much more drastic than has been found necessary in the past. I am well aware of the diffi-

culties and inequity of very drastic pressure reduction in that it is not possible to allow for the wide variations of supply caused by elevation, supplies being always best at the tops of high blocks of flats or to consumers on high ground, with a corresponding worsening to those lower down. So I asked my friend Mr. H. J. Escreet to calculate for me the reduction of output on days of maximum demand due to increased specific gravity. It transpires that in the North Thames area this can be as much as would be required to provide the gas supply to the City of Liverpool, so you will appreciate that specific gravity is a powerful weapon. I feel sure I am right in saying that if our sister industry had a similar and as massive a safeguard as this at its disposal during difficult times, it would not hide its light under a bushel, but laud it to the skies. At the present time I cannot help thinking that specific gravity is as good a friend to us as his relative, plain ordinary gravity has been to all engineers for centuries.

I have tried to tell you what a strong position our industry is in, but again I have been trying to say that strong as it is fundamentally only constant vigilance will keep it there. We must not let our advantages be frittered away by artificially enhanced prices of our raw materials, nor can we retain considerable unremunerative loads at the expense of the general consumer, solely in the interests of what is called commercial expediency.

Benevolent Fund

The inflationary trend in the prices of all commodities, which has become increasingly pronounced for some time past, bears particularly harshly upon those who, in retirement or as dependants of deceased members, dispose of only a small fixed income. This may be in the form of an annuity of some years' standing or as interest on a small nest egg, which, though inviolable in amount, is steadily dwindling in value. Many such cases are receiving assistance from our Benevolent Fund and they are bound to look more and more to the fund to help them to make ends meet. The fund, unfortunately, cannot at present help them adequately. I do appeal, therefore, particularly to those of our members who, probably as an oversight, do not now contribute to the fund, to help us in this charitable work, and to those who do contribute to review the amount they send and see if they cannot now increase it. In the general struggle to keep up with the soaring costs of living, let us not forget those of our fellows who, through no fault of their own, can do little or nothing to help themselves.

Conclusion

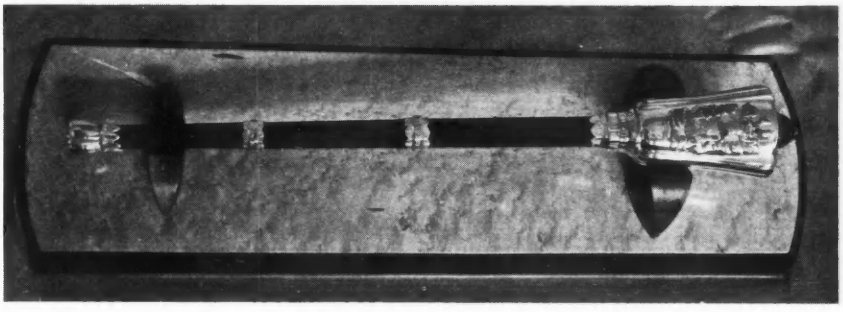
Very soon now I shall have run my presidential course and I shall transfer into the waiting hands of the President-elect the shining torch of the Institution. It has been my endeavour in my year of office to retain and even, if possible, to add something to the brightness of that torch. But I have throughout been very conscious of how much I owe to the constant support of the Institution Council, whose cheerful forbearance, wise guidance and solid loyalty have been a constant inspiration to me. Nor do I forget the daily services rendered to the President, to members individually and to the Institution as a body by the Secretary and his small but able and hard working staff.

I have no fear for the future usefulness and prosperity of the Institution, and I am sure the presidents to come can count on every one of its members jealously to guard its good name and to promote the objects for which it holds its Royal Charter.

THE INSTITUTION MACE

BELOW is a photograph of the mace presented to the Institution of Gas Engineers at the Annual Meeting by Dr. Harold Hartley, Past President of the Institution and Chairman of Radiation Ltd.

The mace is handwrought throughout, and is made of silver, gold, enamel, and ebony. The 'head' and 'tail' are of cast silver, modelled and chased with 9 ct. gold mounts. The pierced top is silver-gilt and is enamelled.



The arms of the Institution is chased and engraved and is 9 ct. gold. The rear symbol is of 9 ct. yellow and white gold, chased and engraved. The shaft is made of ebony, with two engraved silver and gold collars.

The mace rests upon a stand which is made of bird's-eye maple, walnut, and macassar ebony.

The mace weighs 27.5 oz. troy, and was made by Mr. A. Morris, of Morris and Baker, Birmingham, 18, after the design by Cyril J. Shiner, M.S.I.A., Birmingham, 16.

Threshold of Greatest Expansion

Minister's Forecast at President's Luncheon

THE gas industry is on the threshold of the greatest expansion it has ever known. Thirty years ago people said it was a dying industry, but look at it today. It is some corpse! Output has doubled in 30 years; in 1950 it was up by 4%, and already in 1951 it is up by 8.4% over the corresponding period a year ago. We quote from the speech of the Right Hon. Philip Noel-Baker, Minister of Fuel and Power, at the President's luncheon held at the Savoy Hotel on May 29, in which he said the gas industry had a great past, a great present, and an even greater future.

The President, proposing the toast of the guests, extended a cordial welcome to the Right Hon. Philip Noel-Baker, Minister of Fuel and Power; Professor E. N. da C. Andrade, Director in the Royal Institution and Director of the Davy-Faraday Research Laboratory; Sir Edgar Sylvester and Colonel H. C. Smith, Chairman and Deputy Chairman of the Gas Council; the Chairmen of several of the area boards; and Sir Donald Fergusson, Secretary, Ministry of Fuel and Power. He had, he said, spent a little more than half his professional life in the gas industry. From the time he joined it he found it had a close fraternity and a helpful bond between its members which did not exist elsewhere. In recent years it had been his good fortune to be on the Council of the International Gas Union, and he had found that a similar atmosphere existed in all parts of the world where gas was made.

G.J. 3493

Sir Edgar Sylvester, Chairman of the Gas Council, chats with the President at the Luncheon.

It gave him great pleasure to welcome M. Brabant, President of the International Gas Union and of the Belgian Gas Association, together with the Presidents of the French, Swedish, and Austrian Gas Associations; representatives of the Associations in Holland and Norway, and also official representatives of the Governments of Australia, Canada, New Zealand, South Africa, Austria, Belgium, Denmark, France, Holland, Italy, Switzerland, the United States, and a visitor from Brazil. They were pleased to have with them the Presidents of a large number of kindred British institutions, and they welcomed past Presidents, authors of papers, prize winners, members of the Gas Council Research Committee and of the Gas Research Board. He had also to welcome the Press, and particularly the technical Press, whom they looked upon as members of their own family.

The Right Hon. Philip Noel-Baker, Minister of Fuel and Power, responding, said the Institution had a great past, a great present, and an even greater future. Many people had been apprehensive of what would happen to the Institution after nationalisation. The President had already given the answer when he said that the Institution was going from strength to strength. The make of gas this year was 8% more than a year ago. Institution membership had increased by 7%, and he felt certain there was a causal connection between the two. In replying for all the guests he could not mention the name of Sir Edgar Sylvester without saying that he thought the industry was happy in having him as its leader and its head. He was glad to be among colleagues from the Civil Service and from the Ministry which he served, among whom were Sir Donald Fergusson and Mr. R. N. Quirk. The work which they had done for the nation during the winter months had been beyond praise.

Triumphant Success

In his view the gas industry had come through the changes of the past two years with triumphant success. There had been none of the troubles that some people had foreseen, and growing pains had been observed hardly at all. There had been an excellent spirit in the boards and their staffs and among the workers. 'You have inherited from the past a fine tradition of labour relations,' he continued. 'I believe that by the new system of joint consultation you are now devising, which I hope everybody here will support with all his power, that great tradition will in the future be more than upheld.'

In the past winter everybody had pulled together to bring us through what threatened at one time to be a serious crisis. 'We imposed on you a greatly increased use of gas oil and you helped us to conserve our stocks of coal. You co-operated in the switching of coal from one gasworks to another so that all would be, if not adequately, at least sufficiently supplied. You made a big contribution by giving up coal for the house coal market so that the housewife had the coal she needed. You helped to establish the gasworks coal banking scheme whereby the coal merchants were able to supply coal to the housewife; that scheme was tried in some places and it worked successfully. You came through the winter with flying colours, and I believe that looking back over the last two years you can say that you have already got a real achievement to your credit.'

A few months ago Colonel Carr, a great figure in gas for many years, retired from the Chairmanship of the North Western Gas Board, and before he went he claimed some notable successes for the Board, including an average increase of 2% in the gross thermal yield from coal carbonised, representing a saving of some £300,000.

Speaking of the future, the Minister said the basic fact about all the industries which supplied the nation with fuel and power was the unceasing and heavy increase in demand, due in the last resort to the results of full employment. Science, he continued, had an immense contribution to make to the future development of gas. In all the fuel and power industries put together expenditure on research today was about 0.4% of the total turnover. He had not been able to get exact figures for gas, but it was probably not more than 0.25%, whereas some industries spent as much as 4%, 6%, or 8% of their turnover on scientific research. It might be imagined that as gas was an old industry, settled in its ways, it did not need a large expenditure on research, but gas was also a young industry, with a future far greater than its past. Our national use of fuel was wasteful in a scandalously high degree, and he urged them to keep their minds on current research and watch the experiments still in their early stages which were being conducted on the total gasification of coal by Dr. Dent and Mr. Haynes at Poole.

G.J. 3447

Mr. J. F. Ronca, O.B.E., President of the Institute of Fuel, and Miss K. M. Halpin, O.B.E., President of the Women's Gas Federation.

Professor E. N. da C. Andrade, D.SC., Director in the Royal Institution and Director of the Davy-Faraday Research Laboratory, who proposed the toast of

the Institution, said that the Institution had gained the admiration of all interested in technical education by its promotion of the education and training of those who entered and were engaged in the gas industry. The 27th report of the Gas Education Committee made interesting reading. By its fruitful encouragement of research the Institution appealed to men of science; in collaboration with the University of Leeds it had fostered co-operative research in various fields connected with the industry. The Institution merited the good opinion of all citizens by the admirable spirit of co-operation it displayed with all other bodies concerned with gas engineering, particularly the Society of British Gas Industries, the Institution of Civil Engineers, the Ministry of Works, and the Gas Council.

Mr. J. H. Dyde, President-elect, responded and said the composition of the membership of the Institution had changed conspicuously in the last 20 years. There had been an influx of chemists, physicists, and specialists of all kinds, comprising the technicians of the industry, all of whom were embraced under the term of gas engineers. The President had spoken of the Institution going from strength to strength, and it was largely due to the work of the specialists that they found themselves in the happy position they occupied today. They had had in reecnt years high and sometimes artificial rises in the cost of their raw materials. In spite of all their efforts to increase the mechanisation of their processes and to lower the cost per therm by integration of their systems, the labour factor remained a very high one in the cost of gas. Going up and down the country and talking with technologists he had found there was a feeling of urgency and restlessness which was all to the good; a feeling that what had served them in the past would not serve them in the future.

Dr. E. V. Evans, Member of the North Thames Gas Board, proposed the toast of the President. It was usual, he said, for the Chairman of the President's organisation to carry out the task, but Mr. Michael Milne-Watson had already done so on several occasions and had exhausted his list of adjectives and adverbs. The Institution was indeed fortunate in having F.M. ('Field Marshal') Birks as its President. He had won, with success, his year's campaign, and he had also won their hearts.

The President briefly replied.

INSTITUTION BENEVOLENT FUND

Growing Need for Support

THE President presided at the general meeting of the contributors to the Benevolent Fund of the Institution on May 30, and moved the adoption of the report of the Committee of Management for the year 1950-51 and accounts for the year 1950.

This was formally seconded, and the motion was carried.

Dr. W. T. K. Braunholtz, Hon. Secretary, announced that the scrutineers had reported that the two members elected to serve on the Committee of Management for the years 1951-4 were Mr. W. R. Branson and Mr. D. D. Melvin.

Mr. W. K. Tate (Eastern Division, Southern Area), in moving a vote of thanks to the President as Chairman of the Committee of Management, the Committee, the Hon. Secretary, and the visitors who went round to see those whom they endeavoured to assist, said it was suggested in the report that they should all regard the Fund as a measure of insurance. That was very proper, but he felt they ought to have a higher moral thought about it than that. It was more blessed to give than to receive, and those who were prosperous—relatively perhaps, but none the less prosperous—and had health and positions, should spare a thought for those of their colleagues who through no fault of their own had fallen on evil times or had left behind them people who could not look after themselves.

If every member of the Institution—the whole 2,500—were to set aside the cost of a packet of cigarettes, the income of the Benevolent Fund would be increased by nearly 50%. Not one of them in the room or outside, if asked to give that small sum, would refuse to do so. It was a measure of their idleness that they did not do it, and it was a measure of their lack of support that so small a sum from so comparatively few people would make so great a difference to the total which the Management Committee would have available to help those in distress.

Mr. W. Macnaughton (Wolverhampton) said he was glad to second the vote of thanks as he had recently had some practical knowledge of the consideration and work of the Benevolent Committee. It was up to members who were so proud of the standard of the Institution to give some thought to those who had fallen by the wayside and their dependents and, if possible, do something in the way of relief.

S.B.G.I. Golf

Members of the Institution of Gas Engineers supported in strength the summer meeting of the Society of British Gas industries Golfing Circle at Roehampton on May 28. This year, for the first time for several years, the Evening Star Golfing Circle also met in conjunction with the S.B.G.I.-I.G.E. gathering.

The Coronation Plate, open to members of the Institution, was won by S. H. Stokes with a score of 71; with J. Denton (74) 2nd; and W. J. Collins Garrard (76) 3rd.

The Thornton Victory Cup, for members of the S.B.G.I., was won by K. Sheard, with C. R. Averill, Junr. 2nd, and S. C. Thompson 3rd, each with a score of 76.

In the Foursomes J. Hunter Rioch and J. Simpson (2 down) were the winners and D. Fulton and D. Beavis (2 down) 2nd. The scratch prize was won by K. Sheard with a score of 81.

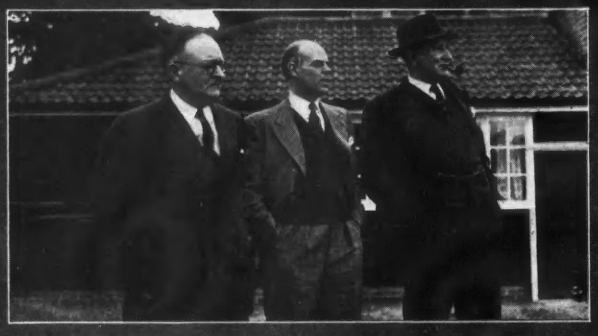
The prizes were presented at the reception and dance at the Connaught Rooms on May 29.

Evening Star Lodge

Members of the Northern Star Lodge (Manchester) and the Murdoch Lodge (Birmingham), and other masonic members of the Institution were the guests of the Evening Star Lodge at Freemasons' Hall, London, on the Monday evening preceding the meeting. Mr. N. Willsmer presided, and in accordance with tradition the Masters of the two provincial lodges (Mr. G. R. Macfarlane of the Northern Star, and Mr. C. H. Woodfine of the Murdoch) took part in the proceedings.

At dinner, Colonel W. M. Carr responded to the toast of the Grand Lodge Officers. For the visitors response was made by Mr. L. Hartley, Mr. Bernard Clarke, Mr. R. J. Rogers, and the Masters of the two sister Lodges.

Earlier in the day members of the Evening Star Golfing Society had been invited to play at the Spring Meeting of the S.B.G.I. Golf Circle at Roehampton; and in the course of the evening Mr. Willsmer presented the Davis Cup to the winner, Mr. Colin T. C. Woodall.



Roehampton, May 28

S.B.G.I.
entertain the
INSTITUTION

Visit to Watson House

G. J. 3470

Dr. Hollings, O.B.E., and Mr. G. C. Holliday welcome overseas visitors—M. Brabant (Belgium), M. Ferlet and E. Biard (France), M. Irminger (Norway).

AN enjoyable afternoon was spent on Wednesday, May 31, touring Watson House and the recently opened Watson House Exhibition. Some 150 visitors were welcomed by Dr. H. Hollings, O.B.E., in the absence of the Chairman of the North Thames Gas Board, who was engaged welcoming other visitors at Beckton.

After assembling in the entrance hall of the exhibition, small parties were formed and it says much for the organisation of the visit that everyone was kept moving steadily round, each party arriving at its appointed place with split second accuracy.

Watson House, although part of the Research Department of the North Thames Gas Board, is also a centre for technical information to other contributing gas boards throughout the country.

This group of laboratories is concerned with the utilisation of gas and coke for domestic, commercial, and industrial purposes, its function being the improvement, in the broadest sense, of service to consumers by increased efficiency and better performance of appliances and reduced installation and maintenance costs.

New appliances are designed, and research and development work carried out on problems associated with the various aspects of fuel services, close contact being kept with the Board's Market Research Section and the consumers' technical service and advisory personnel, from whom much information of value is obtained and who co-operate with the laboratories on field investigations.

British Standards

In addition, chemical, physical, and mechanical tests of proprietary appliances, fittings and stores to British Standards and the Board's specifications are made, and modifications are suggested where necessary.

The fully equipped industrial workshop is of considerable assistance in development work, in that facilities are available on the same site as the laboratories for the production of prototypes of both small domestic and large industrial equipment.

An extensive training school for staff, fitters, and apprentices is also housed close to the laboratories, and this proximity has proved, over many years, to be of considerable mutual value to both departments.

Every year Watson House has some hundreds of visitors, but it has been found that they upset the work of the laboratories and in consequence some form of permanent exhibition which would show the work of the building was desirable. It had to be in graphic form and be easy to explain and understand and it was important that the exhibition should be kept moving.

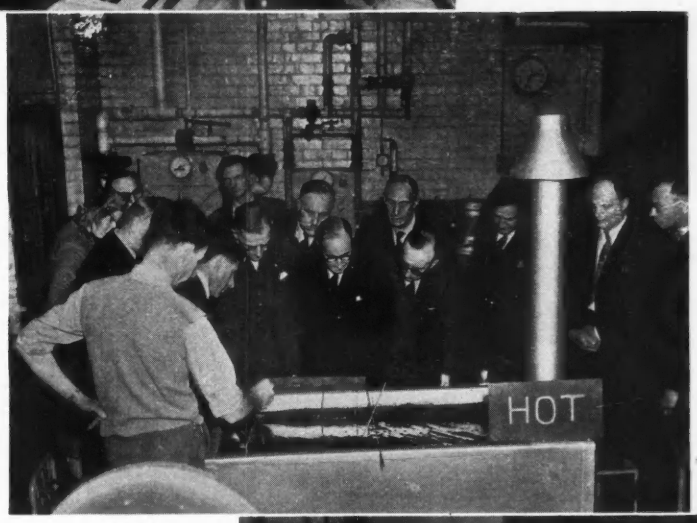
Broadly speaking, it is designed to portray the efficient use of the products of the carbonisation of coal with particular emphasis on the provision of domestic fuel services, and in doing so sums up much of the work of the Watson House Laboratories.

Following the tour, tea was provided in the staff canteen and a vote of thanks to the North Thames Gas Board for a most pleasant afternoon was proposed by Lieut.-Col. J. A. Gould, who deputised for the President of the Institution on this visit, while the sentiments of overseas visitors were aptly expressed by M. Brabant, President of the International Gas Union. Dr. H. Hollings replied.

Laboratories and Exhibition

G J. 3478

Mr. E. W. B. Dunning explains the cooker laboratory where gas quality is studied in relation to cooker efficiency.



G.J. 3473

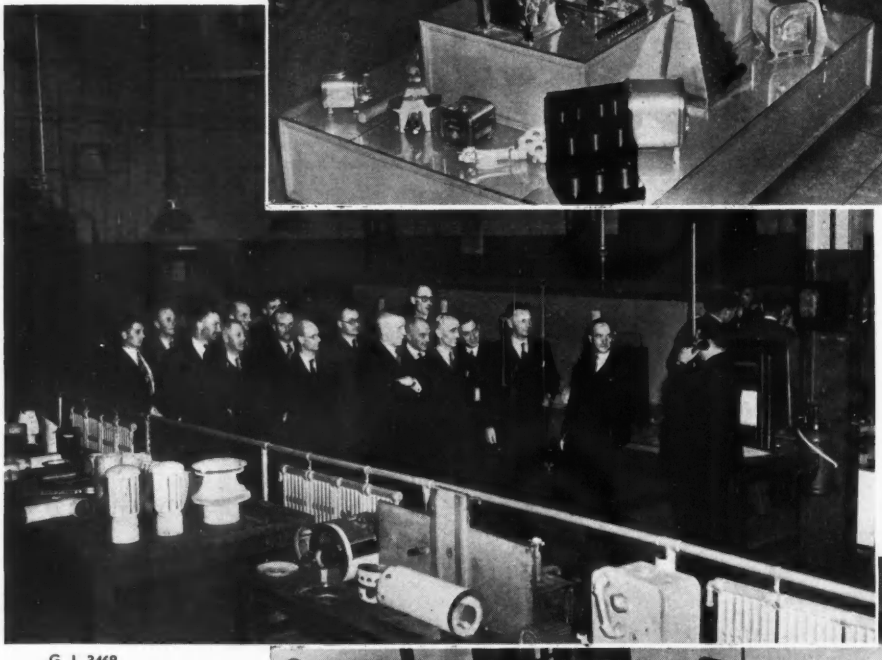
Mr. R. F. Hayman demonstrates the heat flow meter for measuring surface losses from gas-heated tanks.

G. J. 3469

In the mechanical testing laboratory, Mr. Peart deals with the method of apparatus testing

A talk from Mr. Davies in the small industrial fittings laboratory.

G. J. 3472



Mr. R. N. Le Fevre demonstrates the telephone loud speaker training system.

G. J. 3468

Mr. L. W. Andrew shepherds a party through the water heating laboratory.

G. J. 3474

G. J. 3471

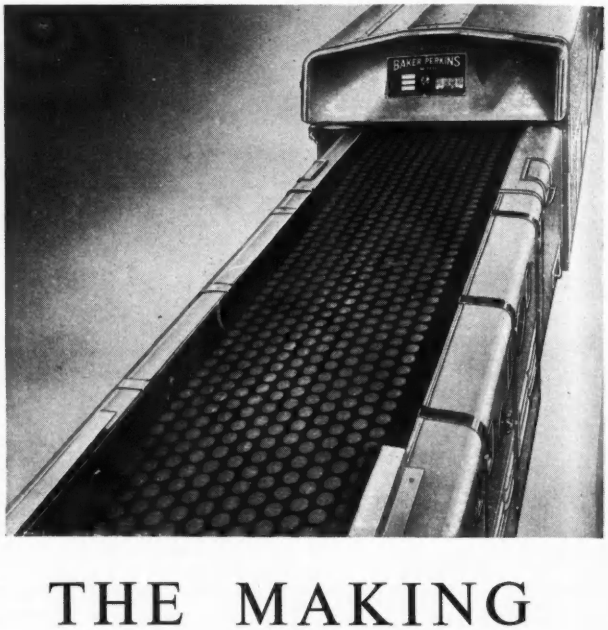
A group in the laboratory where the calibration of flame matching burners is carried out, with Mr. F. E. Mills in attendance.

G.J. 3477

Following a successful tour, votes of thanks were proposed by Lieut-Col. Gould for the Institution and M. Brabant for the overseas visitors, to which Dr. Hollings replied.

G. J. 3476.

G. J. 3475



A Baker Perkins Gas-Fired Travelling Biscuit Oven of the type used by McVitie & Price, Ltd., at Harlesden.

On both the Wednesday and Thursday afternoons parties of members of the Institution visited the Harlesden works of McVitie and Price, Ltd., whose baking ovens consume more than 200,000 therms of gas per annum.

BISCUITS IN THE MAKING

THERE is an indefinable 'something' in the atmosphere of a works or factory which often tells us straight away whether or not we are going to enjoy a tour of inspection or be hard put to it to maintain a polite interest—with one eye on our watch and our thoughts on teatime.

The atmosphere of McVitie & Price's factory at Harlesden, however, left us in no doubt right from the start that we were going to spend a most interesting few hours. Was our certainty assisted perhaps by the atmosphere, in the more literal sense, which immediately assailed our nostrils or by the somewhat exaggerated interest which the ration-weary Britisher now takes in food? At any rate, we should have been less than human had the huge quantities of mouth-watering confections which passed in a seemingly endless stream before your eyes not turned our thoughts instinctively and excusably to, in fact—teatime.

Occupying an area approximately the same as that of the South Bank Festival site, the Harlesden factory is one of three owned by this firm, and while each of the three is a complete manufacturing unit in itself, it is frequently found desirable—more especially in times like these of shortage of many essential materials—to concentrate certain processes at one works which then feeds the other two. For example, the chocolate used for coating biscuits is made at another works.

One of the Packing Sections.

Needless to say, the keynote is cleanliness, and we were told that the whole vast area of the preparation and baking rooms is scrupulously washed down daily—quite a problem in itself we imagine. If an eyebrow were to be raised in query at anything we saw it would be at one tall chimney which dominates the factory—exhaling smoke. To dismiss this—from the gas industry's viewpoint—slight 'black mark' quickly and summarily, we would say that the main power and heat requirements are very sharply defined—for baking, by gas; for power, electricity; and for steam and hot water, by automatically fed coal boilers. We are assured, however, that if any protagonist of smokeless fuel can show the firm an obvious saving in the last-named, they would not be slow to take it up.

The Beginning

In an organisation so big and with operations so varied it is not easy to decide where to start a description, and to the too logical mind which says 'start at the beginning' we would counter 'where is the beginning?' It might be in some English cornfield where experts from the firm inspect the grain for quality, or it might be in some distant Mediterranean land whence comes fruit for the cakes.

So many different ingredients converge from different sources in the mixing rooms (and not being Mrs. Beeton we will not attempt to name them all) that a very general impression of this end must suffice. We are particularly impressed by the milk reception and treatment plant—all of stainless steel—and by the arrangements for storing and

mixing the various oils and fats. The handling of fats in such quantities that a garden spade is the most suitable implement for the purpose is an intriguing thought for the harassed housewife.

Again, big stainless steel trollies are used to transport the fats to the mixing rooms, where the same care and attention to detail is in evidence in preparing the dough in machines which mix hundredweights at a time. Many of the recipes are obviously closely guarded secrets as they must be in a trade where competition is extremely keen; but it is fascinating to watch some of our well-known teatime favourites in the making and to realise how little they are touched by human hand until the one which conveys them on their final journey.

From the mixing machines the dough is fed on to rollers which turn it into bands of the required thickness. It then passes under the cutters and embossers which produce the individual shape and pattern and imprint the name of the particular variety. The individual 'circles' of dough drop away from the original band and go on their way into the oven, while the rest of the band returns to the rollers for re-use, so that there is no waste.

During the past decade the manufacturers of baking equipment have brought their oven design to a fine degree of simplicity. In the main the continuous travelling baking oven can be imagined as being similar to a tunnel with an endless band passing through to form the baking sole. Terminal drums are arranged, one at either end, one drum being utilised to give motion to the band and the drum at the other end being used to maintain the necessary tension in the band.

Adequate controllable means of ventilation are provided to release the steam generated during the baking process, from the baking chamber.

Gas heated ovens are controllable over a wide range. The burners emit a uniform distribution of heat across the entire width of the oven. The control of the heat is extremely simple, and means are provided to vary the heat intensity at different points through the oven length.

Safety Precautions

The most important feature is to eliminate any chance of explosion, and with this end in view the highest measures of safety towards the factory personnel are employed. In this direction automatic means are embodied, to ignite each individual burner. Other essential features in a gas-fired baking oven are, of course, cleanliness and simple controllability.

The consumption of gas is dependent on a number of features, among these being the length of the oven and the class of goods which it is desired to produce. A fair average ratio of gas to goods produced is 2½ cu.ft. of gas per pound of biscuits baked.

The gas ovens at Harlesden are by the two leading manufacturers of this class of equipment—Messrs. Baker Perkins, Ltd., of Peterborough, and T. & T. Vicars, Ltd., of Newton-le-Willows—and while both manufacturers can obviously claim certain specific features and advantages for their particular models, we are not sufficiently foolhardy to embark on so controversial a subject as the relative merits of the two. Suffice it to say that they both perform a job calling for a high degree of technical perfection in a manner which gives their operators every satisfaction, and consume between them some 50 mill. cu.ft. of gas per annum.

What particularly strikes the visitor is the immense length of some of these ovens—up to 210 ft. And it takes from 3 to 30 minutes (according to the variety being baked) for a biscuit to pass through. One such oven will turn out a million biscuits a shift—enough to fill 2,000 a day of the familiar large tins we see at our grocer's. The great length is clearly seen in the accompanying photographs.

From the gas ovens a sufficient length of travel is arranged on the endless belt to allow of adequate cooling before the biscuits feed into convenient channels at the packing benches. Here, white-overalled girls pack them into the familiar big tin which we see at our grocer's. Each tin is carefully weighed, labelled, and sealed prior to being placed on the endless belt which conveys them to the despatching departments. We learn that the shortage of tins causes the firm great inconvenience, and it is not uncommon to see queues of girls waiting to receive tins off the belt from the tin washing department—which means that the packing is being seriously delayed. Each tin bears a small label indicating the exact net weight; but austerity demands that tins for the home market shall carry only a single 'variety' label instead of all over as in the good old days.

We are living in an age of electronic brains and of such wonderful automatic contrivances that machines that do anything short of composing an oratorio are regarded as commonplace. Nevertheless, the automatic packing and weighing machines in this factory are almost human, if that can be regarded as a compliment these days. Mechanical hands dextrously seize the paper and wrap it with lightning speed around the 'column' of biscuits. Others rapidly seal the end of the packet with a sticky label. And the remarkable thing is that whenever there is a blank on the feed, although the mechanical hands go through the motions they do not pick up any paper.

Two Vicars Travelling Ovens

Each separate packet lingers for a brief moment on the automatic weighing machine which is critical to the merest fraction of an ounce. The least error and a mechanical gate closes across the exit from the machine and diverts the packet into the 'rejects' for re-packing. The wrapping paper is prepared and printed in the factory; but owing to the prevailing shortage of paper it is difficult to keep all the automatic packing machines in full operation. Similar machines deal with the packing of certain brands into cartons which in turn are wrapped in what used to be cellophane, but is now more usually semi-transparent paper sealed by an ingenious heat process.

At various stages on the moving belts the tins are subjected to physical and 'electric-eye' checks, each of which is transmitted to a series of dials in the foreman's office. The removal of a tin at any stage in its journey from packing to despatch comes to light when the daily balance is taken.

In the chocolate-coating department the biscuits pass through a cooling chamber to dry the coating. They lie on a rubber belt embossed all over with the maker's name in reverse relief —which explains how the lettering appears on the underside of the chocolate biscuits. In the cake-making department we see the application of smaller double-deck drawplate and 'portable' gas ovens.

As a *pièce de résistance* we are permitted a peep into the export department where we are instantly whisked back, as though on a time machine, a full decade and more into those far off expansive days of almost infinite variety, when due importance was attached to eye appeal as well as taste. Vacuum packed tins, colourful labels (all over—not on just one side), transparent lids exhibiting the goods within, attractive sample tins—and everywhere stout packing cases destined for all parts of the world, with particular emphasis on Canada's dollar market. Some of the 'export only' biscuits include varieties which are little more than a dim memory today.

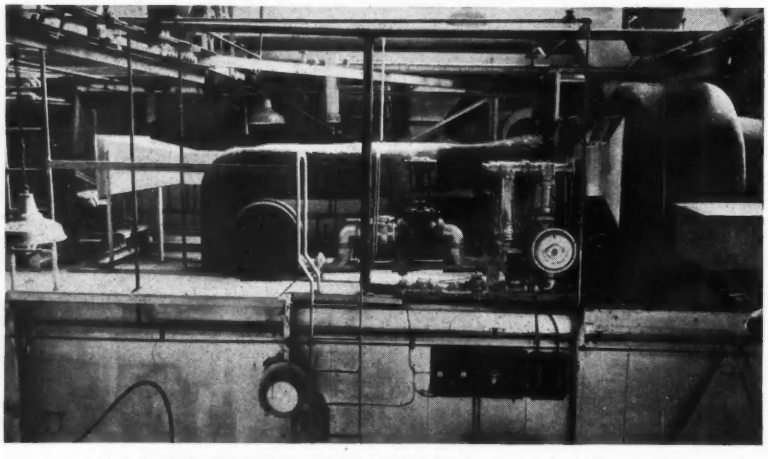
Welfare

McVitie & Price employ at Harlesden some 600 people—slightly more men than girls, and with a staff of this size it is not surprising that special attention is paid to the welfare side. There are rest rooms and fully equipped first-aid section, in the charge of a qualified sister; works canteen, where the cooking is by gas; separate tearooms at several points around the factory so that the operatives may enjoy their 'tea break' close to their point of work but not actually in the process rooms. (Incidentally, the staff receive all 'rejects' for their own consumption.) Then there is a sports ground close by, where the hot water in the pavilion is provided by a coke boiler.

Gas is supplied to the works from an 8 in. main running on the north side of Waxlow Road, which is cross-connected at three points to a 12 in. main on the opposite side of the road. The biscuit bakery is supplied by two 6 in. services which are inter-connected in the meter house and serve seven 6,000 cu.ft. high-capacity meters, each meter supplying a separate biscuit baking oven. Another 6 in. service supplies the cake bakery, where a 6,000 cu.ft. and a 3,000 cu.ft. meter are installed to serve the travelling oven, drawplate ovens and two double-deck peel ovens. The wafer department is served by two meters of 6,000 cu.ft. capacity each, while a number of other supplies serve the engineers shop, office building, canteen, etc. The total installed meter capacity is 71,100 cu.ft. and the annual gas consumption is rather more than 200,000 therms.

This has, perforce, been but a thumb-nail sketch of a very big organisation and a complicated series of processes in which gas plays a vital part. The members of the Institution who selected this visit will long remember an afternoon of outstanding interest.

GAS IN THE PRODUCTION OF MOTOR BODIES



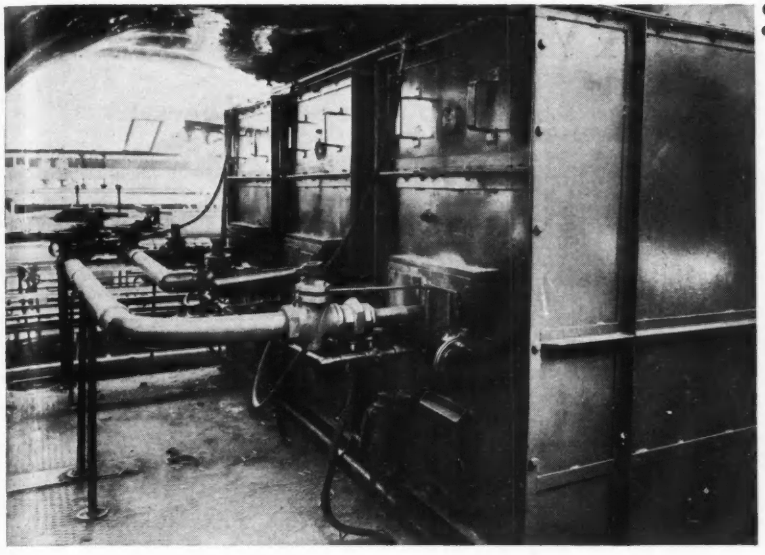
Gas fired furnace for zone No. 1 of primer body bake oven.

One of the visits on the Thursday afternoon was to the Dagenham Works of Briggs Motor Bodies, Ltd., where some 1¼ mill. therms of gas are used per annum.

TO those who have had their names on the waiting list for several years it is tantalising indeed to see new cars coming off the production lines at the rate of dozens an hour. It is true that the articles coming off the lines at the Dagenham works of Briggs Motor Bodies lack certain obvious essentials such as wheels and engine; but the spectacle is nonetheless tantalising—though one gains some consolation, perhaps, from the thought of what this effort contributes towards the lessening of the 'dollar gap.'

These works are mainly concerned with the production of complete bodies for Ford cars, whose plant is only half a mile away. The new 'Consul' and 'Zephyr' models figure largely, of course, in firm's programme at the moment, though the other well-known types, both private and commercial, are still in substantial production. Incidentally, it takes upwards of 12 months to tool up for a completely new model.

Dozens of huge presses stamp out sheet steel body panels, and it is fascinating to watch the different bodies taking shape under one's eyes. The whole process takes place on the 'moving band'



Gas furnace for chassis dip paint bake oven.

The bake ovens are heated by air circulated through direct gas-fired furnaces and are thermostatically controlled. As a safety precaution, electronic flame failure protection devices are fitted to cut off the gas should the gas flame become extinguished.

In addition to the above, a consumption of gas up to 20,000 cu.ft. per hour at 4½ in. W.G. is used in the factory for various operations which include soldering, torch annealing, annealing furnaces for stampings, tool hardening, and canteen cooking equipment to cater for a staff of some 6,000.

At the conclusion of the tour, Mr. E. W. B. Dunning voiced the thanks of the visitors to the firm and to Mr. A. J. Taylor (the Plant Engineer) and the guides.

principle, and while approximately 100 bodies a day are being turned out at the present time this represents only about a third of the plant's capacity. The flat steel sheets can, in fact, be turned into a completed body in approximately one working shift, allowing about 1½ hours from the 'framing buck' to the beginning of the finishing processes, which comprise the various dipping, baking, sanding, ground coat, ground coat sanding, drying off, painting and misting (to produce the 'gloss' finish), hard bake, and final trimming. Careful inspection takes place at many points on the line, including inspectors from the Ford works.

There is a large department devoted to the production of all the internal fittings and upholstery. A section is also concerned with the important function of paint mixing.

Special attention is given to working conditions with particular reference to the extraction of fumes from the paint spraying booths and to humidifying the atmosphere in certain processes. The total gas consumption at these works amounts to about 1¼ mill. therms per annum, supplied through a 12 in. main at 30 in. pressure.

One of the most important processes in the manufacture of motor car bodies is probably the colour finishing. The paint operations in this factory account for the consumption of 50,000 cu.ft. of gas per hour, for, with the exception of the final coat bake ovens (which are steam heated) all the equipment in the various paint shops is heated by gas, supplied through a 12-in. main at 6½ in. W.G.

The sequence of operations is as follows:

Car Body Painting.

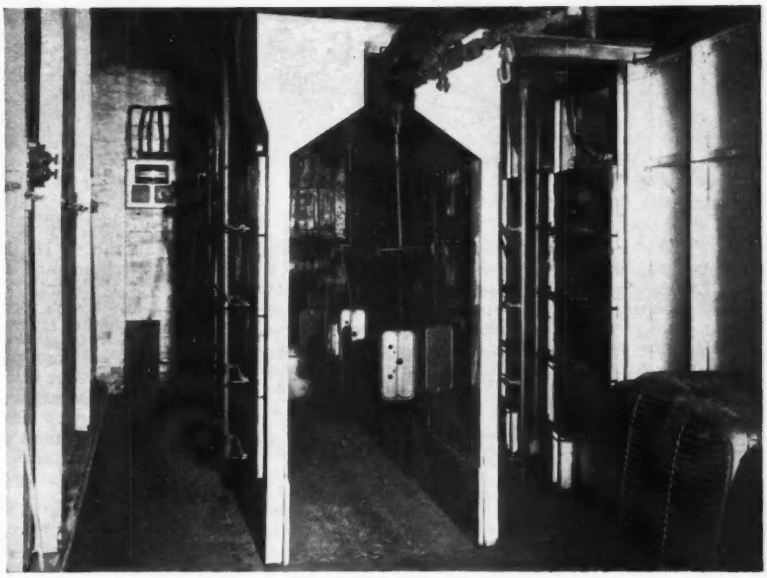
(a) Body bonderising dry-off oven	— 1 furnace	275°-320°F.
(b) Primer paint bake oven	— 5 furnaces	
(c) Primer paint dry-off oven	— 1 furnace	
(d) Ground coat paint bake oven	— 5 furnaces	
(e) Ground coat paint dry-off oven	— 1 furnace	

Car Small Parts Painting.

(a) Small parts bonderising dry-off oven	— 1 furnace	275°-320°F.
(b) Primer paint bake oven	— 5 furnaces	
(c) Ground coat paint bake oven	— 5 furnaces	
(d) Ground coat paint dry-off oven	— 1 furnace	
(e) Dip plant bake oven	— 1 furnace	420°-450°F.
(f) Spray plant bake oven	— 1 furnace	260°-320°F.
(g) Commercial body small parts bake oven	— 1 infra-red furnace	

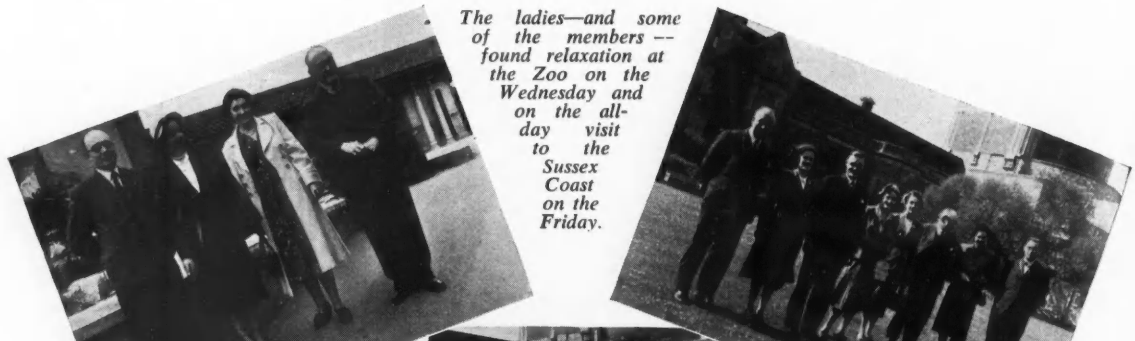
Car Chassis Dip Plant.

(a) Chassis dry-off oven	— 3 heating zones with three, two and one furnaces.	400°-420°F.

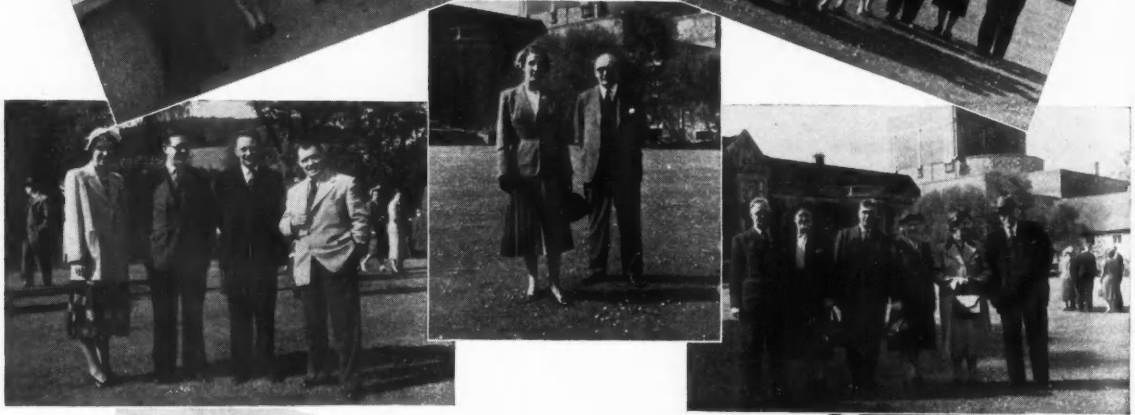


Small parts dip paint bake oven by infra-red gas panels.

VISITS — GRAVE AND GAY



The ladies—and some of the members — found relaxation at the Zoo on the Wednesday and on the all-day visit to the Sussex Coast on the Friday.



A VERY large party, including many ladies, attended the visit to Beckton on the Wednesday afternoon. We have had several opportunities in recent years of describing and illustrating the improvements and extensions continually taking place at this great works, and pressure on our columns precludes our mentioning the many items of interest selected for display during Institution Week. At tea in the Welfare Centre, Mr. Michael Milne-Watson, Chairman of the North Thames Gas Board, welcomed the visitors and said it was most fitting that Mr. Birks in his year as President should lead the party to Beckton, where he had spent seven years of his life.

After the President had made a brief reference to his many happy years with the old Gas Light and Coke Company, Mr. Dyde, President-Elect of the Institution, as deputy to Mr. Birks, who was both host and guest, expressed the appreciation of all the visitors. He thought it was the largest gathering on record at Beckton, and this alone was the greatest compliment to their President. Beckton always showed a new face, and visitors always received a magnificent and traditional welcome, for tradition seemed to live in Beckton's very roots.

Another large party visited the East Greenwich works of the South Eastern Gas Board on the Thursday. The main party went by launch from Westminster Pier, the rest by coach and car. Tea was served in the Board's concert hall, where Mr. W. K. Hutchison welcomed the guests on behalf of the members of the Board, and Mr. Birks expressed warm appreciation of the facilities afforded for the visit.

Also on the Thursday there was a visit to the Brentford works of the North Thames Gas Board, where members were welcomed by Dr. J. Burns, Chief Engineer.

GAS PRODUCTION IN BELGIUM: 1900-1950*

By M. BRABANT,

President of the Belgian Gas Association and of the International Gas Union

IT is not my intention to describe for you the history of the successive transformations undergone by the gas industry since its origin in Belgium. Moreover, to recall the first uncertain steps of the coal distillation industry would not be of particular interest to you. The reason is that it was here, England, where the first Belgian engineers who studied the technique of gasification came to seek inspiration. The construction of the first gasworks in Belgium, which was built in Brussells in 1815, was due to a native of that city, named J. Bte Meeus, who, after staying several times in London, returned to Belgium to proclaim the advantages of the method of lighting adopted in the English capital since 1816 and 'carried out by small balloons of coal gas, fitted with multiple tubes supplying numerous flames at a distance.'

M. BRABANT

Following the example of the capital and during the ensuing half-century the principal towns and communes in Belgium took steps, one after another, to ensure a supply of gas in their territories. By the end of the century there were in the country 75 gasworks supplying altogether some 150 communes with a total population of 2.5 mill. inhabitants out of the 6.7 mill. who then populated the kingdom.

The First World War

By 1914, at the eve of the first world war, Belgium possessed 83 gasworks supplying 368 communes with a total population amounting to a little over 4 mill. inhabitants. At the time, the gas industry still remained a kind of minor branch of the national economy; production was split up among numerous local works, mainly of small or average capacity, which only supplied the demand for gas from a single commune or from a few adjacent communes. The managers at the time, however had a difficult task. They were able engineers who had not only to attempt to improve the often imperfect technique of manufacture, to carry out the maintenance of their plants, and to keep their distribution mains in good order, but also to ensure the perfect behaviour of their customers' meters. In some cases they supplied gas-burning apparatus and undertook to install it in homes. Their intelligence, seeking possible extensions of supply, had to suggest to them the development programme for mains as well as the conditions under which contracts that would favour an increase in production could be made. Our predecessors before 1914 were thus complete gas men, at once manufacturers and distributors, combined with administrators, constructors, and commercial men. While we pay tribute to their science and initiative, it must be recognised that the happy result of their multiple activities owed much to their luck in living in relatively peaceable times.

From the beginning of the century, however, something of a revolutionary nature began to show in the methods used for the distribution of gas in Belgium. In fact, distribution began to attempt to leave the strictly communal area to which it had so far been confined and to enlarge its sphere of influence by providing supplies at a distance.

In certain regions of the country, more especially in Flanders, production was beginning to be concentrated in works that were favourably situated. This tendency was still limited, however, and was the natural corollary of the improvements in the construction of more modern distillation units provided with powerful machinery.

*I.G.E. Communication No. 383.

The 1914-18 war, owing to the serious damage that it caused to gasworks in Belgium, had profound repercussions on the future of the industry. All the works in the north-west and the west of the country had been damaged or, more often, completely destroyed by systematic bombardment. Thus, the works at Passendaele, Langemarck, Menin, Nieuport, Roulers, Deynze, Thielt, Ypres, etc., were destroyed, while the works at Ostend, Bruges, Mons, Wasmuël, Liége, Antwerp-Zurenborg, and so on, had been or were seriously damaged during earlier or later actions.

In the presence of such grave amputations, and faced with additional economic difficulties caused by the rise in the cost of coal and materials, and in wages, it became impossible to justify the enormous investment of capital that the reconstruction of the destroyed works would have required. Yet, a rapid solution was essential because an area that contained one of the largest populations in the country was completely deprived of gas.

Once the country was liberated, in 1918, the distributors of gas found it necessary to obtain the supplies they required, either by approaching large gasworks that had remained intact, or conveniently situated coke ovens that had gas available.

Perhaps it would be advisable here to look a little way into the past and recall that gasworks and coke ovens knew nothing of each other until comparatively recent times. The gasworks made gas and cared little about the quality of the resulting coke, while the coke ovens aimed at the production of quality coke, but neglected the gas, which very often was allowed to burn to waste.

Progress from 1910

It should be remarked that, from 1910 onwards, considerable progress had been made in the design and construction of coke ovens. Among the principal improvements that had been made, mention may be made of the increase in the productive capacity by enlarging the dimensions of the ovens; utilisation of greater rates of heating, thanks to the use of silica materials; improvement in the arrangements for heating, with the object of reducing the heat required for the ovens; replacement of doors that had to be luted, by self-sealing doors; centralisation of coke quenching under a quenching tower; and the use of powerful mechanical aids for the handling as well as the preparation of coke.

All the same, the idea of utilising coke oven gas for purposes which, at that period, were reserved for gasworks properly so called, had gradually progressed in Belgian circles, which were particularly well informed in view of the special experience of Belgian constructors of coke ovens, such as Semet, Piette, Solvay, Coppée, and Lecocq.

In May, 1913, the Bray coke ovens, which belonged to the Société Ougrée-Marihaye, supplied works at Mons and Wasmuël, 20 kilometres away, with gas with a heating value of 5,100 calories. The gas was then obtained by means of a double drum, which separated the product during the first hours of distillation. At the beginning of 1919, the gasworks at Forest, near Brussels, ordered from the Société des Fours Lecocq a battery of horizontal chambers with regenerators, heated by water gas, which constituted its principal production unit. The first gas-producing coke oven was thus established in Belgium. Europe was living in a period of exceptional economic transformation. The situation of the principal coal producing countries made it necessary for them to undertake a complete reorganisation and re-equipment of their industrial enterprises. Under the spur of necessity, there was in Belgium,

as in other countries, a rapid development of the coking and coking by-products industries. Metallurgical and chemical synthesis works made such splendid progress that they took their place in the first rank of the national economy. Owing to the high price of coke, tar, benzole, and ammonia, the gas from metallurgical and chemical coke ovens appeared at the time as a by-product for which the credit balance could show a very small value and which was considered almost as a free surplus. Further, as it was most clearly demonstrated that a mixture of coals of definite qualities would give, when carbonised in a coke oven, a town gas of the same nature as that obtained with coal high in volatile matter distilled in the retorts or chambers of a gasworks, logic suggested the maximum utilisation of coke oven gas to supply town gas mains. It was, however, necessary to purify the coke oven gas with the same care that gasworks had traditionally, for nearly a century, given to the purification of gas in works based on older ideas. From that time the new orientation of the gas industry was to be naturally conditioned for Belgium, and the industry tended towards a largely regional structure.

Among the gasworks and above them there was to follow a greater and greater concentration that took advantage both of technical progress and favourable economic conditions to ensure public supply at the lowest cost. Progressively was seen the disappearance of the small works and the localisation of production in coke ovens, which produced gas but were above all metallurgical, chemical, or mining coking plants.

While certain organisations were formed to intensify manufacture in powerful units in advantageous situations, others were created to carry out the large-scale transportation of gas from region to region, whereas in the last stage the distributors (public corporations or companies), owners of the local or regional supply mains, undertook to supply their customers by virtue of contracts made with local authorities.

Separation of Functions

This structural transformation clearly caused the separation of the various functions that together constituted what, up to that time, was known as the gas-making industry. It was accelerated by the privileged geographical situation of the chief coking plants, as well as by the small area of a territory (a little over 30,000 sq. km.), in which the population is distributed fairly uniformly, with the exception of the Ardennes.

That marked the end of the 100% gas engineer, who was to become rare, a kind of generic curiosity, the species of which can no longer be found in Belgium save in a few works of small or medium size. With regard to transport, three companies have been formed to ensure the large scale supply of gas, over long distances, with high-pressure mains. These are: the Société Distrigaz, founded in 1930 in the centre and the west, the Société Savgaz in the east, and the Companie Régional de Transport d'Energie in the north-west. The most important of these companies is the Société Distrigaz, which alone distributes a daily volume varying between 1,650,000 and 2,225,000 cu. m., roughly 80% of the gas distributed in Belgium. The Distrigaz grid forms a kind of north-south spine of steel main 110 km. long and 500 mm. in dia. This grid comprises a safety loop at its extreme north end. The service pressure can be raised to 5 kg. On this spine are grafted mains of smaller diameter, feeding some 60 service points. Most of this high pressure grid is supplied at present from seven coking plants—namely, Corbonisation Centrale, Brabant, Marly, Aciéries et Minières de la Sambre, Anderlues, Thy-le-Chateau, and Providence.

The Société Regionale de Transport d'Energie, situated in the Province of West Flanders, is supplied with gas from the Zeebrugge coke ovens. It supplies Bruges and neighbourhood, as well as Courtrai Mouscron, and neighbouring communes. The two grids of this Société and of Distrigaz meet at Mouscron near Menin, where exchanges can take place in one direction or in the other, in accordance with the gas available in either grid, or the demands for gas from either of the regions supplied.

In the province of Liége we have the grid of the Société Savgaz, which is isolated from the two preceding companies. Formed in 1931 the Société Savgaz has arranged, since its foundation, to dispose of the gas from the coke ovens of the iron and steel firms Espérance-Longdoz, at Flémalle-Grande; Cockerill, at Seraing, and, later, Ougrée-Marihaye and the Société chimique Chimeuse. (The last named firm has now closed down its coke ovens and obtains its gas for synthesis purposes from the preceding companies.) The Société Savgaz intends shortly to join the Belgian grid to the German grid in the Aix-la-Chapelle region by a feeder from Welkenraedt to Bildchen.

The Distrigaz, Savgaz, and Régionale transport companies play the part of distributor and regulator in their respective districts, and aim at balancing consumption and production, the one by the other. Distribution by the Société Distrigaz is facilitated by the continuous control of supply by means of remote control apparatus and by a 'dispatching' system that fixes day by day the volumes of gas to be supplied by the producers and distributes them between the different compressor stations.

The First Grid

At the inauguration of the first grid, about 1910, the feeders were designed for an average pressure of some 200 to 300 mm. W.G.; the mains were usually of cast iron with bolted joints. Later, with the formation of transport companies came increased volume, increased distances, and increased pressures. It became necessary to review and give close study to all the elements of the grid. Steel alone was then utilised, in the form of very long tubes welded together. This practice, besides facilitating installation, had the great advantage that it not only reduced the extent of leakage, but reduced it practically to zero. The joints, expansion devices, valves, siphons, and filters were carefully brought up to date, as were the compressor stations, which generally used double-effect single-cylinder piston compressors, capable of great flexibility, in addition to rotary and centrifugal compressors, where the gas transport conditions were sufficiently regular. The continuity of the steel mains in regions traversed by electric tramways, often with current return by rails, gave special emphasis to the problem of protecting the mains against deterioration due to stray currents. When, in 1930, the Société Distrigaz established its long distance grid, consisting mainly of welded steel tube 500 mm. in dia., the protective covering of the tubes had been very carefully studied and numerous insulating joints had been inserted to reduce to a minimum any danger of electrolysis due to stray currents. This system did not meet with success and recourse was had to the use of drainage.

At first, drainage was applied to limited lengths by separating them by insulating joints and by attempting to prevent as far as possible any lowering of the potential of the drained structures. The method was improved by the insertion into the drainage circuit of apparatus to ensure the unidirectional flow of current and by placing balancing connections between adjacent structures. The success realised by polarised drainage or by direct drainage, according to the case, led to its systematic application from 1934 onwards.

As a natural consequence more attention was paid to the possibility of protecting the mains from any corrosion whatsoever rather than to attempt by methods that were expensive, but still inefficient, to prevent the circulation of stray currents as these no longer constituted a danger but a useful source of energy for cathodic protection. From 1937, the insufficient protective effect of drainage in certain regions was remedied by developing the method of the removal of current, and this at once received numerous applications. About the same period the classical method of cathodic protection with anodic outflow was applied at various special points, such as passages under rivers and in soils that were particularly corrosive. In Belgium, installations for cathodic protection of all types can be counted by hundreds, while the length of the mains thus protected extends to thousands of kilometres. These protective methods,

which are always designed to ensure that the material to be protected is made electro-negative, prove to be completely efficacious as well as very economical.

After the large scale transport companies, come those who supply gas to domestic and industrial customers and, as such, usually have low pressure mains. In Belgium, these distributors are either public corporations, private companies, or mixed inter-communal societies.

As regards the purely public corporations (organisations depending solely on communal authority and forming part of the communal administration), the cost price of supply could with difficulty only be compared with the cost price of the private companies exploiting concessions. A commune that owns an industry, even if it is prosperous, ofter administers that capital investment very badly; it neglects to bring it up to date and does not hesitate to hold back when faced with budgetary difficulties. This is why the public corporations have in general disappeared one after another during the concentration of the gas industry.

By the law of May 1, 1922, the legislature had desired to protect the public corporations, whose disappearance might not have constituted a technical mistake but could have become a social abuse. This law allowed the communes to join together in the form of inter-communal societies—that is to say, associations designed to deal with interests of a communal order such as the production and distribution of gas. These societies, enjoying the same prerogatives as the communes that they can replace, have thus been authorised to exploit either as a public corporation, or to confer on a private organisation (private or company), or to a communal or inter-communal organisation the task of ensuring the production or distribution of gas.

Uniting of Interests

Accelerated by economic events, this law came too late to allow the 'inter-communalisation' of the means of production, and it is hardly probable that the communes will even regain an initiative that present industrial conditions render more and more difficult. But inter-communalisation offers the possibility to the communes, should they desire it, of uniting their interests in face of the private organisations. To this they are more and more having recourse and every day we see inter-communalisation tending to substitute its action for that of the constituent communes. Under juridical forms which may differ and more particularly under the form of the 'interested public corporation,' the introduction of this principle of organisation results in collaboration between grantees and concessionaires, with a share in charges and profits that proves to be most fertile in its results.

In this way the Société Intercommunale Bruxelloise du Gaz, the first to be formed, dates from 1932, followed by the Intercommunale Gasbedeeling Antwerpen-Hoboken, the Intergaz in the Brussels area, the Antwerpsche Regional Gas Intercommunale Maatschappij, the Antwerpsche Vereeniging Intercommunale Gasbedeeling, the Société Brabançonne du Gaz ('Sobragaz'), the B.O.R.G.I.M., and the Association Liégeoise du Gaz.

To summarise the present method of gas production in Belgium, it can be said that it almost entirely derives from 20 coking plants, of which the largest distills some 3,500 metric tons daily. In addition to these producers, standby plants belonging to the transport grids or, more often, to the distributors, can, if required, supply water gas, air gas, residual gas from chemical syntheses, and blast furnace gas to the extent of 400,000 cu. m. a day, to which methane has been added in recent months. Further, 13 small works continue to supply isolated localities. This gas is transported by the three organisations mentioned previously, and distributed by the companies, public corporations, or inter-communal organisation, in accordance with the following scheme.

If at the eve of the second world war, the Belgian gas industry was no longer the industry supplying lighting gas, as in 1914, it still was mainly concerned with coal distillation with, as special characteristics, a greater concentration of the producing works and liaison with coke ovens belonging to mines and iron and steel works. This orientation, as has already been remarked, was rational at the time when it was decided thanks to the closing down of small works that were generally out of date, and to the production of gas at a low price; and it had the most happy effects on the economics of our industry.

However, this orientation bore with it certain risks, the reality of which subsequently became clear. Carried out under the sign of a specially favourable conjuncture, aided by a financial strength that provided the industry with all the capital it required, it makes the gas industry depend too exclusively on the steel-making industries. This could be observed in a rather dramatic way during the 1940-44 war, and the difficult period that followed it. To make up for the deficiency of the coke ovens, whose supplies of coking fines were rather uncertain, it was necessary to start up rapidly a certain number of small works that had been shut down some years previously. This was, however, their swan song, for when living conditions became more normal, in 1945, these works were again shut down, and this time finally.

Flexible and Robust

If the 1940-44 war confirmed the opinion that coking plants could be worked at rates that could differ considerably from normal, and that in this respect they were flexible and robust to a greater extent than experts had dared to hope, it cannot, however, be denied that the coke ovens cannot follow daily or even weekly requirements with the flexibility of the small works that had disappeared. In fact, those works which distilled coal with a high content of volatile matter had particularly high yields. Further, they possessed complementary plant (water gas and complete gasification units) that made it possible to vary the output within very wide limits and to react quickly to irregularities in consumption.

One of the first methods of increasing the gas available from coking plants, and of rendering their working more flexible, was, without doubt, the replacing of rich gas for heating the ovens by poor gas (1,100 calories) or blast furnace gas (700 to 900 calories), possibly after enrichment. This experience led to the requirement that future ovens should be 'compound'—that is, they should be capable of being heated, according to circumstances, either with rich gas or producer gas.

For existing batteries, with flues that have not been designed for heating with poor gas, a temporary remedy is possible: heating by blue gas, or carburetted water gas, or by mixed gas, *e.g.*, poor gas enriched by dehyrogenated gas where coke oven gas for chemical synthesis is available in excess of requirements. The extra volumes of rich gas freed by heating the batteries with poor gas may, however, still be insufficient owing to ever increasing demand. This is the case in Belgium, where, since 1946, recourse to sources other than coke oven gas has become necessary. On reviewing the classical means available to find extra gas for our industry, we find, in order of increasing calorific value,

(*a*) poor gas or producer gas from coke (1,100 calories);
(*b*) blue gas or water gas of 2,200 calories;
(*c*) carburetted water gas, whose calorific value can be increased according to the degree of carburation, from 2,200 to 4,000 to 4,500 calories;
(*d*) so-called 'total gas' obtained either from ordinary plant (3,300 calories) or improved producers (with a calorific value that can be increased up to 10,000 calories);
(*e*) dehydrogenated gas ('restgas'), a by-product of the manufacture of synthetic ammonia (calorific value, 6,000 to 7,000 calories).

Producer gas, utilised to heat coke ovens, was obviously the first choice as an additive to coke oven gas. Although it contains a high percentage of inert matter, it is of constant quality if made in modern producers with automatic scrubbing, and it can be mixed continuously and uniformly with coal gas.

Water gas, with its well known technique, has been and still is the classical solution in many countries where supplementary gas is required. It has numerous advantages, and is very flexible because it can be carburetted wtih petroleum oils.

The control of production being automatic, the manufacture of blue or carburetted water gas is easy and requires little labour.

Producer gas, like water gas, cannot be added to coal gas in uncontrolled proportions. With the former, the high percentage of nitrogen would soon result in too low a calorific value and a content of inert matter that would not be acceptable under most contracts. Water gas, although its characteristics approach those of what we call normal gas, cannot be added in such high proportion as would give the mixed gas a carbon monoxide content forbidden by the conditions of the contract.

During the second world war and subsequent years that were marked by a great shortage of coking coal, very wide use was made in Belgium of producer and water gas, as the authorities had allowed the conditions of contract to be waived in respect of calorific value, the percentage of inert matter and even the carbon monoxide content. These relaxations ended, however, with the return of more normal conditions. At present, producers who possess water gas plant and wish to base an important part of their output on it are obliged to increase the carburation, either with oils or petroleum gas. Enrichment by propane, which was practised in the United States of America prior to 1940, though it has no special advantages over carburation with oils, also gives a gas with a high content of carbon monoxide and hydrogen. This method of carburation is simple. In Belgium it has been carried out by cracking in Humphreys and Glasgow automatic plant, easily adaptable for that operation, which increases the output by 40%.

Producer gas has been enriched by expanding propane, in the gaseous phase, in the pipelines conveying the gas to the batteries. Producers of the Strache or Delwick-Fleischer type, dating from 1895-1900, give a gas with a calorific value of about 3,300 calories. This gas, although more interesting than poor gas, on account of its calorific value cannot be added in excess to ordinary town gas without affecting its characteristics to an appreciable extent, notably by too great an increase in the carbon monoxide content.

Complete Gasification

The last 15 years have seen the development of processes of complete gasification which have considerably enlarged the range of fuels that can be distilled by treating them in improved producers. These processes have everywhere (in Belgium, and particularly in England) attracted special attention because they do not start with coking coal, or coke, but with non-coking coal. In accordance with the way the operation is carried out the gas produced may have a calorific value ranging between 1,000 and 10,000 calories (a quality that is heavily methanised), passing through all intermediate values.

The aim of the manufacturers (Viag, Demag, Koppers, Pintsch, Winckler, Hillebrand, Lurgi, etc.) of these gasifiers, at a time when coke oven gas was in short supply, was not only to free as much coke oven gas as possible by replacing it by producer gas of suitable calorific value for heating the ovens, but also, and above all, to obtain the volume of gas required for vehicular traction and the manufacture of synthetic products, such as bunas, plastics, fabrics, and so on. These processes apply more particularly to lignites, low value fuels of which there are important deposits in Germany.

In countries lacking natural reserves of low priced fuels, such processes have a possible future only on condition that either cheap oxygen is available or a free source of exterior heat that, by freeing the calories required for the endothermic water gas reaction, makes it possible to increase the calorific value of the gas produced. I know that in England the Lurgi process has been carefully studied since the war.

British opinion cannot but be very valuable to us, as the fuel situation in Great Britain is very similar to that in Belgium. With you, we think that the Winckler, Lurgi, and other processes are of no economic interest save for a fuel of low rank and a cheap supply of oxygen. We think that under present conditions it is not possible to make complete gasification the basis of our production of gas, and that it is equally impossible, in view of the enormous capital investment and the cost of maintenance required, to make it a means of accessory or seasonal production. These processes have not been tried in Belgium. It seems to me, after reading your technical papers, that you appear to tend, when a source of oxygen is available, to utilise it in producers of the classical type with revolving grate or ash fusion; combined blowing with steam and oxygen reduces the inerts and increases quite appreciably the calorific value of the gas produced. The same practice has been followed at times in Belgium. Naturally, for the process to be economically acceptable the price of oxygen will have to remain under a certain value. Poor gas enriched in this way is then utilised as make up gas for distribution; its smaller content in inerts permits its addition in larger proportions to ordinary mains gas.

Some Problems of the Coke Oven Industry

During the last two years, the problem of gas production has developed notably in Belgium, where the coke oven situation had become extremely difficult since the end of 1948. Coke ovens can only attain economic equilibrium with a remunerative price of coke, their principal end product.

It is a fact that the coking plants naturally tend to consider gas as a by-product. The production of gas, at a time of crisis in the steel industry, matters little to them beyond the minimum volumes laid down in their supply contracts with the gas transport concerns. Consequently, the supplies from the coking plants, reduced to these volumes of 'fatal gas,' soon become insufficient to meet the increased needs of customers, both domestic and industrial, all the more as the consumptions of the steel works and chemical synthesis plants, which form part of the same industrial complex as the coking plants, have become considerable. The fall in the price of coke on international markets, following on the industrial slump and the monetary adjustments of 1949, dangerously accentuated the deficit of Belgian coking plants until the second quarter of 1950. This worsening of the situation was so serious that most of the coking plants had considerably reduced production, and some had even closed down some batteries.

To give an example, from 1932 (the date of foundation) to the end of 1939, an important coking plant had lost nearly 60% of the value of its capital assets; another plant, founded in 1927, by 1935 had to reduce its capital by 50% because of losses amounting to over 72 mill. francs.

That was the situation last August, when we were hoping for a reduction in the price of coal, very high in Belgium, which would have made it possible to sell surplus Belgian coke on international markets. Conditions in Asia, the resulting armament drive, which goes beyond events in Korea, and the buying panic of the people have led to a shortage in the supply of both large coke and graded domestic coke. The exhaustion of stocks and the stabilisation of the market have caused a notable rise in quotations. Present prices should now enable the coking plants to make provision in their balance-sheets for normal depreciation and to ensure their solvency, which was quite compromised.

New difficulties now arise, due to the shortage of coking coal. It has become necessary to distil graded or screened coals whose prices are notably higher than those of fines, and to import American coal, though the cost of its transport to Europe alone is more than its selling price at the mine. As the price of steel is no longer questioned, and as the needs of the steel works for coke are pressing, the coke oven gas available easily covers the needs of the grids in present circumstances. (Exception must obviously be made for heavy winter peak loads, to meet which supplementary plant must be started up.)

Even though the gas industry now finds itself in a state of well being, it should not be forgotten that both brutal and profound reversals of the situation are always possible. Further, it should not be lost sight of that, in addition to disorderly movements like those of recent months, the price of coke follows a descending curve. From 1922 to 1939,

the part that metallurgical coke played in the value of the products of the Belgian coking plants decreased continuously. This situation can only become more and more accentuated as the numerous batteries now being built in France, Great Britain, the Rhineland, Holland, Scandinavia, Poland, Czechoslovakia, Turkey, and as far away as India, are brought into production. It is, therefore, not prudent to increase the number of coking plants too greatly, lest when the international atmosphere becomes more calm the industry may find itself faced by a market over-stocked with coke, which might have the result that the only plants that could exist would be those linked with works that are direct consumers of coke. Under that alternative, the distribution of coke oven gas would again have to face the difficulties of 1950, with the further difficulty that, in the interval, the demands for gas will have still further increased. Statistics show, in fact, the increasing development of industrial utilisation and the extension of heating, which, in post-war years in Belgium, has been favoured by the abnormally low price of gas and the rationing of solid fuels.

Faced with worries that recall those caused by the rapid growth of lighting in the early days of its existence, the Belgian gas industry, instructed by cruel experience, realises that it is time to put an end to the dependence in which it has been kept for nearly 20 years by the coke industry.

The gas industry must seek to break out from the narrow circle within which it works, due to the fact that, in coal carbonisation, gas production is too closely connected with coke production. More attention must be paid to processes that utilise raw materials other than coal and to any source of gas of economic interest that is independent of the coke and steel industries.

Up to recent years, when the coking crisis had not attained its recent severity, coking plants and gasworks were seeking processes of gasification that could yield more and more energy over and beyond the limits given by the treatment of coal alone. Before finding new methods our industry has always resorted, during recent winters, to the use of petroleum oils as the indispensable complement to meet deficiencies in gas. As most of our large producers of gas do not own water gas plants, improvisation was required to make up for the deficiency of the coking plants due to the poor market for coke.

Soaking With Fuel Oil

The soaking of coking coal with fuel oil, a practice widely used by the Americans and carried out either by spraying fuel oil on the coal face in the mine (which decreases dust), or by mixing coal with 1 to 3% of its weight of high viscosity combustible oils, has been tried out and applied generally in most of the chief Belgian coking plants and gasworks during recent winters. Fuel oil injectors were installed either at the top of the coal bunkers or above the coal-car hoppers and the oil incorporated averaged 2% of the coal treated. This method of applying the oil is not perfect; often the coal is soaked unequally and the premature release of hydrocarbons at the beginning of coking causes a loss of calories. The utilisation of petroleum oils in this way without complicated apparatus in a classical installation, the coke oven, has all the same made it possible to increase quite appreciably the yield of gas from the batteries and to produce a gas of improved calorific value, thanks to its higher content of methane and the decrease of inerts. In addition, and this was an unforeseen extra advantage, the bulk density of the charge is appreciably increased by the incorporation of fuel oil in the coal. Generally, it has been considered an advantage to limit the percentage of added oils to 1.5%. The object of this is to obtain good cracking at any moment of coking and to ensure that the products leading to benzole should be completely converted to cyclic compounds. (Aliphatic products can be a nuisance if the works produce pure benzene products.)

In certain works, the above process has been replaced by the cracking of gas oil or fuel oil, which is not incorporated in the coal, but injected directly into the retorts or chambers. This cracking has been tried and carried out in various ways, either by introducing the fuel oil to the chamber filled with red hot coke at the end of the period of distillation, or by spraying it into the empty chamber at a temperature between 700° and 1,000°C. The most satisfactory results were obtained by injecting the oil, by suitable sprays, through the doors of the chambers. This procedure has been tested and used chiefly by the S. A. Carbonisation Centrale at Tertre, by the coking plant at Brussels, and by the Société Chimeuse.

According as steam, or air, or both in definite proportions, are introduced at the same time as the fuel oil, the composition of the gas produced is modified, as well as its calorific value and density. Although it is possible in practice to obtain, starting with oil, gas that can be substituted for town gas by increasing the hot cracking of the hydrocarbons, thus increasing the hydrogen content of the resulting gas, it is preferable, in order to obtain a good yield, to aim at the production of a rich gas. The simultaneous introduction of steam and air results in a gas with a high carbon monoxide content, a lower gross calorific value, and a higher density than the gas yielded with added steam alone. The rich gas obtained in either case constitutes, in the circumstances, an additive that can be diluted as required, either by producer gas or water gas, if an excessive content of carbon monoxide in the final gas is not objected to.

It appears that with an oil corresponding to light fuel oil with the characteristics

Density, 0.854 at 15°C.;
Engler viscosity, 1.85 at 20° C.;
Open flash-point, 127°C.;
Fire-point, 145°C.;
Beginning of distillation at 242°C.;
Gas yield on distillation, 80% at 360°C.,

and gasified with 300 g. of steam per kg. of fuel oil, the average yield of gas is 6.2 mill. gross calories per metric ton of fuel oil, thus giving an output of about 1,500 cu.m. (reduced to 4,200 calories at 0°C. and 760 mm. Hg) of a gas containing 20 to 30% of C_nH_{2n}, 20 to 25% of H_2, and about 40% of CH_4.

At the Brussels coking plant, analyses of gas samples from the ascension pipe of the oven, when cracking in an empty chamber with steam injection, but no air, have shown the flexibility of the process in which, according to the quantity of oil injected in unit time, the proportion of steam and the chamber temperature can be used to obtain a considerable variation in the volume and the quality of the gas obtained.

With the increase in temperature and steaming, the content of hydrogen is considerably increased, and therefore, also, the volumetric yield of the operation. However, as the dissociation of the steam is endothermic, more heat must be supplied to the chambers, so that the heat balance of the conversion may become less economic.

Following are a few examples showing the gas obtained with different rates of cracking:

	Normal Gas	(1)	(2)	(3)	(4)	(5)
CO_2	4.0	4.0	2.2	1.9	2.0	2.2
$C_n H_{2n}$	2.6	20.2	26.8	42.7	15.9	15.3
O_2	0.4	0.6	0.6	0.2	0.7	0.8
CO	8.4	5.8	2.4	3.1	7.4	11.7
H_2	46.6	21.2	20.8	3.9	23.4	24.0
CH_4	20.6	29.0	39.4	40.4	45.0	40.0
N_2	17.4	19.2	8.0	7.8	5.6	6.0
	100.0	100.0	100.0	100.0	100.0	100.0
Inerts (with O_2)...	21.8	23.8	10.8	9.9	8.3	9.0
Calorific value measured (cal.)	4,280	6,497	8,509	10,589	10,124	11,954

In test No. 3, note should be taken of the high content of hydrocarbon and the low percentage of hydrogen, both indicating insufficient heating and steaming and, consequently, imperfect cracking of the heavy hydrocarbons. Tests Nos. 4 and 5 were carried out with the same feed of oil, but at different rates of steaming; steaming was forced in test No. 5. To sum up, under average operating conditions, with a

chamber 12 m. long, 4.2 m. high and 0.425 m. wide (average), the quantity of gas made in 24 hr. can attain the equivalent in calories of 25,000 cu.m. of gas emitted for a consumption of 750 to 800 kg. of oil per hr.

A chemical coking plant, the Société Chimeuse, has used fuel-oil cracking by injecting the oil on to the block of finished coke before ejecting it. This method was soon abandoned because the gas produced contains too little hydrogen to meet the requirements for synthesis. It was replaced by the method in which heavy fuel oil mixed with superheated steam is cracked in an empty chamber. The products from this thermal decomposition passed through a tube into the adjacent chamber, where the hydrocarbons were cracked still further and the steam reacted on the carbon formed.

The final gas, with a calorific value of 2,800 calories, had the following composition:—

	%
CO_2	9
$C_n H_{2n}$	1
CO	19
O_2	1
H_2	59
CH_4	3
N_2	8

The chamber cracking of fuel oil does not offer any practical difficulty if care is taken to avoid the deposition of graphite on the walls or hearth of the chamber by maintaining a high temperature and by injecting sufficient steam. It has been found indispensable to ensure that the oil is injected in a very fine spray that does not fall directly on the walls of the chamber. The process has the advantage that it not only gives a higher yield than when the coal is merely soaked with oil, but also that it can be started instantaneously and makes it possible, as we have seen, in accordance with the feed of the oil, steam (and possibly air), to vary the quality and the volume of the gas produced within wide limits. Further, if sufficient steam is injected, the process is not subject to the apparently justified criticism that has been made against the soaking process: that it gives a dark appearance to the coke due to the slight layers of carbon, and also that the gas is dirty with powdered graphite.

Another source of thermal energy can be found in residual gas from refineries. In Belgium, the cost of propane and butane is high, certainly too high for use as a raw material, while they would still be acceptable for the carburation of water gas if regular supplies were less difficult and storage were less costly.

However, beyond the necessity for economic caution, it is permissible to think that, when refineries now under construction at the petroleum port of Antwerp are started up, considerable volumes of residual gases (ethane, ethylene, propane, propylene, butane, butylene, and mixtures of these) will become available for the gas industry after the chemical industries have satisfied their requirements for the manufacture of derivatives. At the same time, by using heavy fuel oils obtained in Belgium at prices per calorie that normally would not be higher than those of coking fines, it should be possible, if tests confirm the validity of methods of cracking such oils, to consider from that standpoint a new orientation of gas manufacture, with a net decrease in cost price.

Recovery and Utilisation of Firedamp

The methods for the recovery of firedamp that were perfected in Belgian coal mines in 1949 have recently induced the gas industry to consider an orientation based on new sources of energy. In fact, the utilisation of natural gases offers most encouraging prospects in view of the low cost of the raw material and the ease with which a gas can be obtained, either by cracking or simple partial combustion, that may be directly substituted for normal gas. It is not within our scope to discuss the technique of the collection of firedamp in coal mines. That technique has been described in detail in the 'Bulletin technique de l'Institut National Belge de l'Industrie Charbonniere' and in the 'Revue Générale du Gaz.' In this method, holes are bored in one or more seams that have not been affected by working, and then an adjacent seam is worked in such a way as to loosen the unworked seams; the fire-damp escaping from the bore holes is then collected. The bores are either made as the coal face advances or before any coal is won. In the latter case, seams are opened up in the layer immediately above the seam that is to be worked first, and then boreholes are put down to tap the layer itself near the subjacent veins that contain firedamp.

The first attempt to collect firedamp was made at the Grand Trait pit of the Charbonnage de l'Agrappe at Frameries. The firedamp is collected in pipelines extending horizontally 1,200 m. between the boreholes and La Cour pit. It is sent to the Société Carbonisation Centrale à Tertre. It was first utilised there, diluted with gas of low calorific value, to heat the batteries, but this was in the initial stages. Soon an attempt was made to crack the firedamp in a chamber oven. The conversion was carried out under steaming at the rate of 4,800 to 4,900 cu.m. of rich gas per 24 hr. in the presence of a catalyst.

Composition of the Gas

The composition of the gas, with a calorific value of 7,600 calories (0°C. and 760 mm. Hg) was as follows:—

	%
CO_2	2.7
CH_4	80.2
O_2	3.8
N_2	15.3

The composition of the gas after conversion was:—

	%
CO_2	2.2
CH_4	12.1
O_2	0.2
CO	19.8
H_2	58.8
N_2	6.9

The calorific value was reduced to 3,500 calories. If the contents of CH_4 and H_2 in the initial and final gas are compared, it appears that the conversion takes place in accordance with the equation

$$CH_4 + H_2O = CO + 3H_2 \text{——} 50.7 \text{ Cal.}$$

The yield of the operation, calculated from the ratio between the final calories and the sum of the initial calories and the calories supplied as heat was 77.3% on an average. It will be noted that the gas obtained contained a high percentage of hydrogen; it was diluted with distribution gas of which it reduced both the calorific value and the density.

Firedamp was really utilised for public distribution on March 27, 1950. A large collecting and transport grid has been projected in order to utilise firedamp from numerous pits in the Borinage and Centre coalfields. This grid is already well on its way to completion, and the Borinage and Centre coalfields yield, respectively, 60,000 and 120,000 cu.m. of gas daily. The gas, at the openings of the boreholes, has a calorific value of as much as 8,500 calories, is completely free from hydrogen sulphide, and contains a minimum of 90% of methane. Apparently it contains the gas helium in a proportion that is not negligible. The transport concern Distrigaz, which took the initiative in collecting the gas in the pits mentioned above, has ordered from the United States of America materials for the installation of the first plant for the cracking and re-forming of methane. This plant will be erected at the Ste. Aldegonde pit of the Charbonnages de Ressaix-Leval-Peronnes-Ste. Aldegonde-Genck. The plant, which will be started up a few weeks, will be able to treat 60,000 cu.m. of firedamp a day. The conversion will be carried out in carborundum tubes heated to 1,300°C. in the presence of a catalyst. If necessary, the addition of air and steam will prevent the deposition of fine carbon. This will be the first installation of its kind in Europe. While the plant is being completed the firedamp already collected by exhausters at 15 stations is not lost. At the centre stations it is mixed with coke oven gas, poor gas, and blast furnace gas in such proportions as to obtain a gas that can replace

normal gas. Part of the firedamp, mixed with air, is piped to certain industrial consumers, who state that they are delighted with this methanised air because of its perfectly constant composition and its calorific value. At the Borinage stations the firedamp collected is sent, as has been done at Frameries, to the Société Anonyme Carbonisation Centrale at Tertre, where the methane is at present used to the best advantage, either for heating the ovens, for cracking, or by mixing with water gas, producer gas, etc., in accordance with the needs of distribution and of the complex Carbonisation Centrale-Carbochimique. In any case, the calories of the methane are added to the calories of coal gas and other gases. Already, the firedamp mixed with coal gas and gas of lower calorific value, is transported beyond Brussels by the high pressure Distrigaz mains. The methane is introduced into the grid at 4,250 calories (450 B.Th.U.) by groups of compressors that raise the pressure of 2,000 to 3,000 mm. W.G. of the firedamp mains to the 3 to 5 atm. pressure of the grid. Firedamp has also been collected successfully in the Campine mines; since the beginning of last February, gas is being collected at the Winterslag mines. It can now be stated that conditions in a large number of Belgian mines are very favourable for collection. As the volume of methane evacuated daily from Belgian mines is estimated at 2 mill. cu.m. the interest of collection is evident, though it can only be applied in mines rich in firedamp. It should be stated that the utilisation of this new national source of thermal energy for the common good and in a record time is due to private initiative and capital. For a mine where firedamp is collected this constitutes an extra source of income. Further, it gives great advantages as regards the working conditions of the miners, since the air is much purer at the coal face and in the roads.

Underground Gasification

In Belgium, in view of the labour crisis that occurred after the country was liberated, the National Scientific Research Fund, founded by King Albert, subsidised a research syndicate to study underground gasification. The Belgian Government, the chief Belgian companies, the French mines, and also the Polish mines have since then considerably increased the funds available for experimental work. The general management of the work is assumed by a tri-partite International Committee, and its execution is the responsibility of the Belgian Socogaz concern. The experimental station is situated at Wandre, near Liége, the Bois-la-Dame centre of the Société Anonyme des Charbonnages de Bonne-Espérance, Batterie et Violette, in a coal mine that had been abandoned owing to the difficulty of extraction. The coal seam treated was situated between the —187 and —67 m. levels, and the volatile content was only 10.5%, which was a cause of inferiority.

During the tests it was found possible to produce, using cold air as a carburant, a poor gas of 800 to 1,000 calories that could be used as a source of energy for the generation of electricity. When using air enriched with oxygen the calorific value was increased to 1,200 calories, which was further increased to 2,000 calories by the injection of steam and oxygen. These special additions, however, were only used for fairly short periods.

Obviously, the conditions for the production of gas *in situ* are much more difficult to realise than in an ordinary producer. The reacting surfaces are much smaller for the same mass of coal, and lower temperatures increase the difficulty of reaction. The accumulation of ash, which cannot be reduced, tends to smother the fire, neglecting the fact that the fire, running along the coal face, tends, instead of remaining stable, to flare up and leave behind it unburnt fuel. Many problems remain of which the final solution becomes more complex and delicate as the control of various underground phenomena intervening in the operation is but partially realised. The gas industry, however, will only consider underground gasification interesting on condition that it can supply a gas of sufficiently high calorific value that does not contain too much inert matter and can be used to dilute a rich gas. This is not yet the case in Belgium, where the results so far obtained are insufficient to enable sufficiently accurate conclusions to be drawn regarding the best method of recuperating the residual energy of unexploited coal deposits.

Conclusion

In conclusion, I hope that my remarks will be of value both to your country and my own, and also to any other countries where the gas industry is now seeking new sources of gas. Certainly, in our own countries, it is logical that the coke oven should remain one of the chief means of producing gas, for coke is always the corner stone of our steel industries and should, therefore, be available in sufficient quantities in the country itself. But the Belgian gas industry, at present too closely connected with the coking and metallurgical industries, is in such a state of vassalage that it must try to break free. Submitted as it is, by its nature as a transforming industry, to all the upheavals, all the shocks that may occur in the market for power, it must guard against them. Taking normal evolution of things into account, it is agreed that in Belgium we have, or will have, supplementary sources deriving on the one hand from the gas from petroleum refineries, on the other from methane from coal mines rich in firedamp—valuable and important sources. Holding out a hand to the coal and petroleum industries, the gas industry will find in them valuable and abundant supplies that will enable it to benefit from the greatly enlarged and more adaptable supplies of town gas.

In what proportions will these various sources intervene in general and future distribution? It would be difficult to say at present. The future of each of the sources considered depends largely on the respective levels of the prices of the raw materials, coal, petroleum oils, natural gas, or refinery gas; also on the value of the by-products, such as coke and synthetic products, and on financial charges. And what is true today may not be true tomorrow.

DISCUSSION

Mr. E. Crowther (Chairman of the Northern Gas Board) said that M. Brabant had paid them a high compliment in presenting the paper, which gave them an opportunity of comparing their own difficulties and problems with those of another country. It was of the utmost interest to them to learn something of the work which was being done on the most recent developments, particularly in the matter of the employment of firedamp occluded in coal seams. With characteristic ability and energy the Belgians were making immediate and practical use of this latest development in technology which he hoped to see very soon copied in this country in those parts of the coalfields where the percentage of these gases was sufficient to warrant such a development. It appeared to him a most brilliant conception that a substance which hitherto had proved an expensive and dangerous nuisance should be exploited as a valuable fuel and as a means of appreciably diminishing the demands of the gas industry upon the coal resources of the country. There were a number of possible uses for such gases when collected, and he hoped that the National Coal Board would regard the gas industry as its natural and logical collaborator in putting any such gases as might be recovered to the greatest advantage in the national economy.

Oil Availability and Price

In Belgium, the close correspondence between the available quantity of this gas estimated to be available and the total quantity at present distributed to consumers was striking. The close relationship between the gas estimated to be available—although some of it might be in such small proportions as not to be worth recovery—and the total demand for gas of all kinds, appeared to be significant. The prospects of underground gassification, on the other hand, as a contributor to the requirements of the gas industry, appeared to him to be remote.

as in other countries, a rapid development of the coking and coking by-products industries. Metallurgical and chemical synthesis works made such splendid progress that they took their place in the first rank of the national economy. Owing to the high price of coke, tar, benzole, and ammonia, the gas from metallurgical and chemical coke ovens appeared at the time as a by-product for which the credit balance could show a very small value and which was considered almost as a free surplus. Further, as it was most clearly demonstrated that a mixture of coals of definite qualities would give, when carbonised in a coke oven, a town gas of the same nature as that obtained with coal high in volatile matter carbonised in the retorts or chambers of a gasworks, logic suggested the maximum utilisation of coke oven gas to supply town gas mains. It was, however, necessary to purify the coke oven gas with the same care that gasworks had traditionally, for nearly a century, given to the purification of gas in works based on older ideas. From that time the new orientation of the gas industry was to be naturally conditioned for Belgium, and the industry tended towards a largely regional structure.

Among the gasworks and above them t[illegible] to follow a greater and greater concentration that t[illegible]tage both of technical progress and favourable eco[illegible]nditions to ensure public supply at the lowest cost. h[illegible]gressively was seen the disappearance of the small works [illegible]rive the localisation of production in coke ovens, which pro[illegible] but were above all metallurgical, chemical, or minir[illegible] plants.

While certain organisations were formed [illegible]sify manufacture in powerful units in advantageou[illegible]ns, others were created to carry out the large-scale t[illegible]on of gas from region to region, whereas in the last s[illegible]stributors (public corporations or companies), owne[illegible] local or regional supply mains, undertook to supply [illegible]omers by virtue of contracts made with local author[illegible]

Separation of Functions

This structural transformation clearly cau[illegible] separation of the various functions that together const[illegible]vhat, up to that time, was known as the gas-making [illegible] It was accelerated by the privileged geographical situ[illegible] chief coking plants, as well as by the small area[illegible] (a little over 30,000 sq. km.), in which the popula[illegible] d fairly uniformly, with the exception of the A[illegible]

That marked the end of the 100% gas engir[illegible]as to become rare, a kind of generic curiosity, the [illegible] which can no longer be found in Belgium save in [illegible]orks of small or medium size. With regard to transp[illegible]ree companies have been formed to ensure the large [illegible]supply of gas, over long distances, with high-pressure mai[illegible] These are: the Société Distrigaz, founded in 1930 in[illegible]atre and the west, the Société Savgaz in the east, and the Co[illegible]nie Régionale de Transport d'Energie in the north-west. The [illegible]st important of these companies is the Société Distrigaz, w[illegible]h alone distributes a daily volume varying between 1,650,00[illegible]nd 2,225,000 cu. m., roughly 80% of the gas distributed in[illegible]lgium. The Distrigaz grid forms a kind of north-south spin[illegible]f steel main 110 km. long and 500 mm. in dia. This gri[illegible]omprises a safety loop at its extreme north end. The s[illegible]ressure can be raised to 5 kg. On this spine are gra[illegible]ns of smaller diameter, feeding some 60 service poi[illegible]: of this high pressure grid is supplied at present fron[illegible]a coking plants—namely, Corbonisation Centrale, Bra[illegible] Marly, Aciéries et Minières de la Sambre, Anderlues, Th[illegible]-Chateau, and Providence.

The Société Regionale de Transport d'Energie, situated in the Province of West Flanders, is supplied with gas from the Zeebrugge coke ovens. It supplies Bruges and neighbourhood, as well as Courtrai Mouscron, and neighbouring communes. The two grids of this Société and of Distrigaz meet at Mouscron near Menin, where exchanges can take place in one direction or in the other, in accordance with the gas available in either grid, or the demands for gas from either of the regions supplied.

In the province of Liége we have the grid of the Société Savgaz, which is isolated from the two preceding companies. Formed in 1931 the Société Savgaz has arranged, since its foundation, to dispose of the gas from the coke ovens of the iron and steel firms Espérance-Longdoz, at Flémalle-Grande; Cockerill, at Seraing, and, later, Ougrée-Marihaye and the Société chimique Chimeuse. (The last named firm has now closed down its coke ovens and obtains its gas for synthetic purposes from the preceding companies.) The Société [illegible] intends shortly to join the Belgian grid to the [illegible] the Aix-la-Chapelle region by a feeder from Bildchen.

The Distrigaz, Savgaz, and Régionale transport companies play the part of distributor and regulator in their respective districts, and aim at balancing consumption and production, the one by the other. Distribution by the Société Distrigaz is facilitated by the continuous control of supply by means of remote control apparatus and by a 'dispatching' system that fixes day by day the volumes of gas to be supplied by the producers and distributes them between the different compressor stations.

The First Grid

At the inauguration of the first grid, about 1910, the feeders were designed for an average pressure of some 200 to 300 mm. W.G.; the mains were usually of cast iron with bolted joints. Later, with the formation of transport companies came increased volume, increased distances, and increased pressures. It became necessary to review and give close study to all the elements of the grid. Steel alone was then utilised, in the form of very long tubes welded together. This practice, besides facilitating installation, had the great advantage that it not only reduced the extent of leakage, but reduced it practically to zero. The joints, expansion devices, valves, siphons, and filters were carefully brought up to date, as were the compressor stations, which generally used double-effect single-cylinder piston compressors, capable of great flexibility, in addition to rotary and centrifugal compressors, where the gas transport conditions were sufficiently regular. The continuity of the steel mains in regions traversed by electric tramways, often with current return by rails, gave special emphasis to the problem of protecting the mains against deterioration due to stray currents. When, in 1930, the Société Distrigaz established its long distance grid, consisting mainly of welded steel tube 500 mm. in dia., the protective covering of the tubes had been very carefully studied and numerous insulating joints had been inserted to reduce to a minimum any danger of electrolysis due to stray currents. This system did not meet with success and recourse was had to the use of drainage.

At first, drainage was applied to limited lengths by separating them by insulating joints and by attempting to prevent as far as possible any lowering of the potential of the drained structures. The method was improved by the insertion in the drainage circuit of apparatus to ensure the unidirectional flow of current and by placing balancing connections between adjacent structures. The success realised by polarised drainage or by direct drainage, according to the case, led to systematic application from 1934 onwards.

As a natural consequence more attention was paid to the possibility of protecting the mains from any corrosion whatsoever rather than to attempt by methods that were expensive, but still inefficient, to prevent the circulation of stray currents as these no longer constituted a danger but a useful source of energy for cathodic protection. From 1937, the insufficient protective effect of drainage in certain regions was remedied by developing the method of the removal of current, and this at once received numerous applications. About the same period the classical method of cathodic protection with anodic outflow was applied at various special points, such as passages under rivers and in soils that were particularly corrosive. In Belgium, installations for cathodic protection of all types can be counted by hundreds, while the length of the mains thus protected extends to thousands of kilometres. These protective methods

which are always designed to ensure that the material to be protected is made electro-negative, prove to be completely efficacious as well as very economical.

After the large scale transport companies, come those who supply gas to domestic and industrial customers and, as such, usually have low pressure mains. In Belgium, these distributors are either public corporations, private companies, or mixed inter-communal societies.

Of the purely public corporations (organisations depending on communal authority and forming part of the communal administration), the cost price of supply could with difficulty only be compared with the cost price of the private companies exploiting concessions. A commune that owns an industry, even if it is prosperous, ofter administers that capital investment very badly; it neglects to bring it up to date and does not hesitate to hold back when faced with budgetary difficulties. This is why the public corporations have in general disappeared one after another during the concentration of the gas industry.

By the law of May 1, 1922, the legislature had desired to protect the public corporations, whose disappearance might not have constituted a technical mistake but could have become a social abuse. This law allowed the communes to join together in the form of inter-communal societies—that is to say, associations designed to deal with interests of a communal order such as the production and distribution of gas. These societies, enjoying the same prerogatives as the communes that they can replace, have thus been authorised to exploit either as a public corporation, or to confer on a private organisation (private or company), or to a communal or inter-communal organisation the task of ensuring the production or distribution of gas.

Uniting of Interests

Accelerated by economic events, this law came too late to allow the 'inter-communalisation' of the means of production, and it is hardly probable that the communes will even regain an initiative that present industrial conditions render more and more difficult. But inter-communalisation offers the possibility to the communes, should they desire it, of uniting their interests in face of the private organisations. To this they are more and more having recourse and every day we see inter-communalisation tending to substitute its action for that of the constituent communes. Under juridical forms which may differ and more particularly under the form of the 'interested public corporation,' the introduction of this principle of organisation results in collaboration between grantees and concessionaires, with a share in charges and profits that proves to be most fertile in its results.

In this way the Société Intercommunale Bruxelloise du Gaz, the first to be formed, dates from 1932, followed by the Intercommunale Gasbedeeling Antwerpen-Hoboken, the Intergaz in the Brussels area, the Antwerpsche Regional Gas Intercommunale Maatschappij, the Antwerpsche Vereeniging Intercommunale Gasbedeeling, the Société Brabançonne du Gaz ('Sobragaz'), the B.O.R.G.I.M., and the Association Liégeoise du Gaz.

To summarise the present method of gas production in Belgium, it can be said that it almost entirely derives from 20 coking plants, of which the largest distills some 3,500 metric tons daily. In addition to these producers, standby plants belonging to the transport grids or, more often, to the distributors, can, if required, supply water gas, air gas, residual gas from chemical syntheses, and blast furnace gas to the extent of 400,000 cu. m. a day, to which methane has been added in recent months. Further, 13 small works continue to supply isolated localities. This gas is transported by the three organisations mentioned previously, and distributed by the companies, public corporations, or inter-communal organisation, in accordance with the following scheme.

If at the eve of the second world war, the Belgian gas industry was no longer the industry supplying lighting gas, as in 1914, it still was mainly concerned with coal distillation with, as special characteristics, a greater concentration of the producing works and liaison with coke ovens belonging to mines and iron and steel works. This orientation, as has already been remarked, was rational at the time when it was decided thanks to the closing down of small works that were generally out of date, and to the production of gas at a low price; and it had the most happy effects on the economics of our industry.

However, this orientation bore with it certain risks, the reality of which subsequently became clear. Carried out under the sign of a specially favourable conjuncture, aided by a financial strength that provided the industry with all the capital it required, it makes the gas industry depend too exclusively on the steel-making industries. This could be observed in a rather dramatic way during the 1940-44 war, and the difficult period that followed it. To make up for the deficiency of the coke ovens, supplies of coking fines were rather uncertain, it was necessary to start up rapidly a certain number of small works that had been shut down some years previously. This was, however, their swan song, for when living conditions became more normal, in 1945, these works were again shut down and this time finally.

Flexible and Robust

If the war confirmed the opinion that coking plants could be worked at rates that could differ considerably from normal, and that in this respect they were flexible and robust to a greater degree than experts had dared to hope, it cannot, however, be denied that the coke ovens cannot follow daily or even hourly requirements with the flexibility of the small works that have disappeared. In fact, those works which distilled coals with a high content of volatile matter had particularly high outputs. Further, they possessed complementary plant (gasholders and complete gasification units) that made it possible to vary the output within very wide limits and to react quickly to irregularities in consumption.

One of the first methods of increasing the gas available from coke ovens plants, and of rendering their working more flexible, was, without doubt, the replacing of rich gas for heating the batteries by poor gas (1,100 calories) or blast furnace gas (700 calories), possibly after enrichment. This experience has the requirement that future ovens should be 'convertible'—that is, they should be capable of being heated, in all circumstances, either with rich gas or producer gas.

In the case of batteries, with flues that have not been designed for heating with poor gas, a temporary remedy is possible: this is to add flue gas, or carburetted water gas, or by mixed gas, or gas enriched by dehyrogenated gas where coke oven gas for chemical synthesis is available in excess of requirements. The extra volumes of rich gas freed by heating the batteries with poor gas may, however, still be insufficient owing to ever increasing demand. This is the case in Belgium, where, since 1946, recourse to sources other than coke oven gas has become necessary. On reviewing the classical means available to find extra gas for our industry, we find, in order of increasing calorific value,

(*a*) producer gas or producer gas from coke (1,100 calories);
(*b*) blue gas or water gas of 2,200 calories;
(*c*) carburetted water gas, whose calorific value can be increased according to the degree of carburation, from 3,300 to 4,000 to 4,500 calories;
(*d*) so-called 'total gas' obtained either from ordinary producer gas (3,300 calories) or improved producers (with a calorific value that can be increased up to 10,000 calories);
(*e*) dehydrogenated gas ('restgas'), a by-product of the manufacture of synthetic ammonia (calorific value, 6,000 to 7,000 calories).

Producer gas, utilised to heat coke ovens, was obviously the first choice as an additive to coke oven gas. Although it contains a high percentage of inert matter, it is of constant quality if made in modern producers with automatic scrubbing, and it can be mixed continuously and uniformly with coal gas.

Water gas, with its well known technique, has been and still is the classical solution in many countries where supplementary gas is required. It has numerous advantages, and is very flexible because it can be carburetted wtih petroleum oils.

The control of production being automatic, the manufacture of blue or carburetted water gas is easy and requires little labour.

Producer gas, like water gas, cannot be added to coal gas in uncontrolled proportions. With the former, the high percentage of nitrogen would soon result in too low a calorific value and a content of inert matter that would not be acceptable under most contracts. Water gas, although its characteristics approach those of what we call normal gas, cannot be added in such high proportion as would give the mixed gas a carbon monoxide content forbidden by the conditions of the contract.

During the second world war and subsequent years that were marked by a great shortage of coking coal, very wide use was made in Belgium of producer and water gas, as the authorities had allowed the conditions of contract to be waived in respect of calorific value, the percentage of inert matter and even the carbon monoxide content. These relaxations ended, however, with the return of more normal conditions. At present, producers who possess water gas plant and wish to base an important part of their output on it are obliged to increase the carburation, either with oils or petroleum gas. Enrichment by propane, which was practised in the United States of America prior to 1940, though it has no special advantages over carburation with oils, also gives a gas with a high content of carbon monoxide and hydrogen. This method of carburation is simple. In Belgium it has been carried out by cracking in Humphreys and Glasgow automatic plant, easily adaptable for that operation, which increases the output by 40%.

Producer gas has been enriched by expanding propane, in the gaseous phase, in the pipelines conveying the gas to the batteries. Producers of the Strache or Delwick-Fleischer type, dating from 1895-1900, give a gas with a calorific value of about 3,300 calories. This gas, although more interesting than poor gas, on account of its calorific value cannot be added in excess to ordinary town gas without affecting its characteristics to an appreciable extent, notably by too great an increase in the carbon monoxide content.

Complete Gasification

The last 15 years have seen the development of processes of complete gasification which have considerably enlarged the range of fuels that can be distilled by treating them in improved producers. These processes have everywhere (in Belgium, and particularly in England) attracted special attention because they do not start with coking coal, or coke, but with non-coking coal. In accordance with the way the operation is carried out the gas produced may have a calorific value ranging between 1,000 and 10,000 calories (a quality that is heavily methanised), passing through all intermediate values.

The aim of the manufacturers (Viag, Demag, Koppers, Pintsch, Winckler, Hillebrand, Lurgi, etc.) of these gasifiers, at a time when coke oven gas was in short supply, was not only to free as much coke oven gas as possible by replacing it by producer gas of suitable calorific value for heating the ovens, but also, and above all, to obtain the volume of gas required for vehicular traction and the manufacture of synthetic products, such as bunas, plastics, fabrics, and so on. These processes apply more particularly to lignites, low value fuels of which there are important deposits in Germany.

In countries lacking natural reserves of low priced fuels, such processes have a possible future only on condition that either cheap oxygen is available or a free source of exterior heat that, by freeing the calories required for the endothermic water gas reaction, makes it possible to increase the calorific value of the gas produced. I know that in England the Lurgi process has been carefully studied since the war.

British opinion cannot but be very valuable to us, as the fuel situation in Great Britain is very similar to that in Belgium. With you, we think that the Winckler, Lurgi, and other processes are of no economic interest save for a fuel of low rank and a cheap supply of oxygen. We think that under present conditions it is not possible to make complete gasification the basis of our production of gas, and that it is equally impossible, in view of the enormous capital investment and the cost of maintenance required, to make it a means of accessory or seasonal production. These processes have not been tried in Belgium. It seems to me, after reading your technical papers, that you appear to tend, when a source of oxygen is available, to utilise it in producers of the classical type with revolving grate or ash fusion; combined blowing with steam and oxygen reduces the inerts and increases quite appreciably the calorific value of the gas produced. The same practice has been followed at times in Belgium. Naturally, for the process to be economically acceptable the price of oxygen will have to remain under a certain value. Poor gas enriched in this way is then utilised as make up gas for distribution; its smaller content in inerts permits its addition in larger proportions to ordinary mains gas.

Some Problems of the Coke Oven Industry

During the last two years, the problem of gas production has developed notably in Belgium, where the coke oven situation had become extremely difficult since the end of 1948. Coke ovens can only attain economic equilibrium with a remunerative price of coke, their principal end product.

It is a fact that the coking plants naturally tend to consider gas as a by-product. The production of gas, at a time of crisis in the steel industry, matters little to them beyond the minimum volumes laid down in their supply contracts with the gas transport concerns. Consequently, the supplies from the coking plants, reduced to these volumes of 'fatal gas,' soon become insufficient to meet the increased needs of customers, both domestic and industrial, all the more as the consumptions of the steel works and chemical synthesis plants, which form part of the same industrial complex as the coking plants, have become considerable. The fall in the price of coke on international markets, following on the industrial slump and the monetary adjustments of 1949, dangerously accentuated the deficit of Belgian coking plants until the second quarter of 1950. This worsening of the situation was so serious that most of the coking plants had considerably reduced production, and some had even closed down some batteries.

To give an example, from 1932 (the date of foundation) to the end of 1939, an important coking plant had lost nearly 60% of the value of its capital assets; another plant, founded in 1927, by 1935 had to reduce its capital by 50% because of losses amounting to over 72 mill. francs.

That was the situation last August, when we were hoping for a reduction in the price of coal, very high in Belgium, which would have made it possible to sell surplus Belgian coke on international markets. Conditions in Asia, the resulting armament drive, which goes beyond events in Korea, and the buying panic of the people have led to a shortage in the supply of both large coke and graded domestic coke. The exhaustion of stocks and the stabilisation of the market have caused a notable rise in quotations. Present prices should now enable the coking plants to make provision in their balance-sheets for normal depreciation and to ensure their solvency, which was quite compromised.

New difficulties now arise, due to the shortage of coking coal. It has become necessary to distil graded or screened coals whose prices are notably higher than those of fines, and to import American coal, though the cost of its transport to Europe alone is more than its selling price at the mine. As the price of steel is no longer questioned, and as the needs of the steel works for coke are pressing, the coke oven gas available easily covers the needs of the grids in present circumstances. (Exception must obviously be made for heavy winter peak loads, to meet which supplementary plant must be started up.)

Even though the gas industry now finds itself in a state of well being, it should not be forgotten that both brutal and profound reversals of the situation are always possible. Further, it should not be lost sight of that, in addition to disorderly movements like those of recent months, the price of coke follows a descending curve. From 1922 to 1939,

the part that metallurgical coke played in the value of the products of the Belgian coking plants decreased continuously. This situation can only become more and more accentuated as the numerous batteries now being built in France, Great Britain, the Rhineland, Holland, Scandinavia, Poland, Czechoslovakia, Turkey, and as far away as India, are brought into production. It is, therefore, not prudent to increase the number of coking plants too greatly, lest when the international atmosphere becomes more calm the industry may find itself faced by a market over-stocked with coke, which might have the result that the only plants that could exist would be those linked with works that are direct consumers of coke. Under that alternative, the distribution of coke oven gas would again have to face the difficulties of 1950, with the further difficulty that, in the interval, the demands for gas will have still further increased. Statistics show, in fact, the increasing development of industrial utilisation and the extension of heating, which, in post-war years in Belgium, has been favoured by the abnormally low price of gas and the rationing of solid fuels.

Faced with worries that recall those caused by the rapid growth of lighting in the early days of its existence, the Belgian gas industry, instructed by cruel experience, realises that it is time to put an end to the dependence in which it has been kept for nearly 20 years by the coke industry.

The gas industry must seek to break out from the narrow circle within which it works, due to the fact that, in coal carbonisation, gas production is too closely connected with coke production. More attention must be paid to processes that utilise raw materials other than coal and to any source of gas of economic interest that is independent of the coke and steel industries.

Up to recent years, when the coking crisis had not attained its recent severity, coking plants and gasworks were seeking processes of gasification that could yield more and more energy over and beyond the limits given by the treatment of coal alone. Before finding new methods our industry has always resorted, during recent winters, to the use of petroleum oils as the indispensable complement to meet deficiencies in gas. As most of our large producers of gas do not own water gas plants, improvisation was required to make up for the deficiency of the coking plants due to the poor market for coke.

Soaking With Fuel Oil

The soaking of coking coal with fuel oil, a practice widely used by the Americans and carried out either by spraying fuel oil on the coal face in the mine (which decreases dust), or by mixing coal with 1 to 3% of its weight of high viscosity combustible oils, has been tried out and applied generally in most of the chief Belgian coking plants and gasworks during recent winters. Fuel oil injectors were installed either at the top of the coal bunkers or above the coal-car hoppers and the oil incorporated averaged 2% of the coal treated. This method of applying the oil is not perfect; often the coal is soaked unequally and the premature release of hydrocarbons at the beginning of coking causes a loss of calories. The utilisation of petroleum oils in this way without complicated apparatus in a classical installation, the coke oven, has all the same made it possible to increase quite appreciably the yield of gas from the batteries and to produce a gas of improved calorific value, thanks to its higher content of methane and the decrease of inerts. In addition, and this was an unforeseen extra advantage, the bulk density of the charge is appreciably increased by the incorporation of fuel oil in the coal. Generally, it has been considered an advantage to limit the percentage of added oils to 1.5%. The object of this is to obtain good cracking at any moment of coking and to ensure that the products leading to benzole should be completely converted to cyclic compounds. (Aliphatic products can be a nuisance if the works produce pure benzene products.)

In certain works, the above process has been replaced by the cracking of gas oil or fuel oil, which is not incorporated in the coal, but injected directly into the retorts or chambers. This cracking has been tried and carried out in various ways, either by introducing the fuel oil to the chamber filled with red hot coke at the end of the period of distillation, or by spraying it into the empty chamber at a temperature between 700° and 1,000°C. The most satisfactory results were obtained by injecting the oil, by suitable sprays, through the doors of the chambers. This procedure has been tested and used chiefly by the S. A. Carbonisation Centrale at Tertre, by the coking plant at Brussels, and by the Société Chimeuse.

According as steam, or air, or both in definite proportions, are introduced at the same time as the fuel oil, the composition of the gas produced is modified, as well as its calorific value and density. Although it is possible in practice to obtain, starting with oil, gas that can be substituted for town gas by increasing the hot cracking of the hydrocarbons, thus increasing the hydrogen content of the resulting gas, it is preferable, in order to obtain a good yield, to aim at the production of a rich gas. The simultaneous introduction of steam and air results in a gas with a high carbon monoxide content, a lower gross calorific value, and a higher density than the gas yielded with added steam alone. The rich gas obtained in either case constitutes, in the circumstances, an additive that can be diluted as required, either by producer gas or water gas, if an excessive content of carbon monoxide in the final gas is not objected to.

It appears that with an oil corresponding to light fuel oil with the characteristics

Density, 0.854 at 15°C.;
Engler viscosity, 1.85 at 20° C.;
Open flash-point, 127°C.;
Fire-point, 145°C.;
Beginning of distillation at 242°C.;
Gas yield on distillation, 80% at 360°C.,

and gasified with 300 g. of steam per kg. of fuel oil, the average yield of gas is 6.2 mill. gross calories per metric ton of fuel oil, thus giving an output of about 1,500 cu.m. (reduced to 4,200 calories at 0°C. and 760 mm. Hg) of a gas containing 20 to 30% of C_nH_{2n}, 20 to 25% of H_2, and about 40% of CH_4.

At the Brussels coking plant, analyses of gas samples from the ascension pipe of the oven, when cracking in an empty chamber with steam injection, but no air, have shown the flexibility of the process in which, according to the quantity of oil injected in unit time, the proportion of steam and the chamber temperature can be used to obtain a considerable variation in the volume and the quality of the gas obtained.

With the increase in temperature and steaming, the content of hydrogen is considerably increased, and therefore, also, the volumetric yield of the operation. However, as the dissociation of the steam is endothermic, more heat must be supplied to the chambers, so that the heat balance of the conversion may become less economic.

Following are a few examples showing the gas obtained with different rates of cracking:

	Normal Gas	(1)	(2)	(3)	(4)	(5)
CO_2	4.0	4.0	2.2	1.9	2.0	2.2
$C_n H_{2n}$	2.6	20.2	26.8	42.7	15.9	15.3
O_2	0.4	0.6	0.6	0.2	0.7	0.8
CO	8.4	5.8	2.4	3.1	7.4	11.7
H_2	46.6	21.2	20.8	3.9	23.4	24.0
CH_4	20.6	29.0	39.4	40.4	45.0	40.0
N_2	17.4	19.2	8.0	7.8	5.6	6.0
	100.0	100.0	100.0	100.0	100.0	100.0
Inerts (with O_2)...	21.8	23.8	10.8	9.9	8.3	9.0
Calorific value measured (cal.)	4,280	6,497	8,509	10,589	10,124	11,954

In test No. 3, note should be taken of the high content of hydrocarbon and the low percentage of hydrogen, both indicating insufficient heating and steaming and, consequently, imperfect cracking of the heavy hydrocarbons. Tests Nos. 4 and 5 were carried out with the same feed of oil, but at different rates of steaming; steaming was forced in test No. 5. To sum up, under average operating conditions, with a

chamber 12 m. long, 4.2 m. high and 0.425 m. wide (average), the quantity of gas made in 24 hr. can attain the equivalent in calories of 25,000 cu.m. of gas emitted for a consumption of 750 to 800 kg. of oil per hr.

A chemical coking plant, the Société Chimeuse, has used fuel-oil cracking by injecting the oil on to the block of finished coke before ejecting it. This method was soon abandoned because the gas produced contains too little hydrogen to meet the requirements for synthesis. It was replaced by the method in which heavy fuel oil mixed with superheated steam is cracked in an empty chamber. The products from this thermal decomposition passed through a tube into the adjacent chamber, where the hydrocarbons were cracked still further and the steam reacted on the carbon formed.

The final gas, with a calorific value of 2,800 calories, had the following composition:—

	%
CO_2	9
$C_n H_{2n}$	1
CO	19
O_2	1
H_2	59
CH_4	3
N_2	8

The chamber cracking of fuel oil does not offer any practical difficulty if care is taken to avoid the deposition of graphite on the walls or hearth of the chamber by maintaining a high temperature and by injecting sufficient steam. It has been found indispensable to ensure that the oil is injected in a very fine spray that does not fall directly on the walls of the chamber. The process has the advantage that it not only gives a higher yield than when the coal is merely soaked with oil, but also that it can be started instantaneously and makes it possible, as we have seen, in accordance with the feed of the oil, steam (and possibly air), to vary the quality and the volume of the gas produced within wide limits. Further, if sufficient steam is injected, the process is not subject to the apparently justified criticism that has been made against the soaking process: that it gives a dark appearance to the coke due to the slight layers of carbon, and also that the gas is dirty with powdered graphite.

Another source of thermal energy can be found in residual gas from refineries. In Belgium, the cost of propane and butane is high, certainly too high for use as a raw material, while they would still be acceptable for the carburation of water gas if regular supplies were less difficult and storage were less costly.

However, beyond the necessity for economic caution, it is permissible to think that, when refineries now under construction at the petroleum port of Antwerp are started up, considerable volumes of residual gases (ethane, ethylene, propane, propylene, butane, butylene, and mixtures of these) will become available for the gas industry after the chemical industries have satisfied their requirements for the manufacture of derivatives. At the same time, by using heavy fuel oils obtained in Belgium at prices per calorie that normally would not be higher than those of coking fines, it should be possible, if tests confirm the validity of methods of cracking such oils, to consider from that standpoint a new orientation of gas manufacture, with a net decrease in cost price.

Recovery and Utilisation of Firedamp

The methods for the recovery of firedamp that were perfected in Belgian coal mines in 1949 have recently induced the gas industry to consider an orientation based on new sources of energy. In fact, the utilisation of natural gases offers most encouraging prospects in view of the low cost of the raw material and the ease with which a gas can be obtained, either by cracking or simple partial combustion, that may be directly substituted for normal gas. It is not within our scope to discuss the technique of the collection of firedamp in coal mines. That technique has been described in detail in the 'Bulletin technique de l'Institut National Belge de l'Industrie Charbonniere' and in the 'Revue Générale du Gaz.' In this method, holes are bored in one or more seams that have not been affected by working, and then an adjacent seam is worked in such a way as to loosen the unworked seams; the fire-damp escaping from the bore holes is then collected. The bores are either made as the coal face advances or before any coal is won. In the latter case, seams are opened up in the layer immediately above the seam that is to be worked first, and then boreholes are put down to tap the layer itself near the subjacent veins that contain firedamp.

The first attempt to collect firedamp was made at the Grand Trait pit of the Charbonnage de l'Agrappe at Frameries. The firedamp is collected in pipelines extending horizontally 1,200 m. between the boreholes and La Cour pit. It is sent to the Société Carbonisation Centrale à Tertre. It was first utilised there, diluted with gas of low calorific value, to heat the batteries, but this was in the initial stages. Soon an attempt was made to crack the firedamp in a chamber oven. The conversion was carried out under steaming at the rate of 4,800 to 4,900 cu.m. of rich gas per 24 hr. in the presence of a catalyst.

Composition of the Gas

The composition of the gas, with a calorific value of 7,600 calories (0°C. and 760 mm. Hg) was as follows:—

	%
CO_2	2.7
CH_4	80.2
O_2	3.8
N_2	15.3

The composition of the gas after conversion was:—

	%
CO_2	2.2
CH_4	12.1
O_2	0.2
CO	19.8
H_2	58.8
N_2	6.9

The calorific value was reduced to 3,500 calories. If the contents of CH_4 and H_2 in the initial and final gas are compared, it appears that the conversion takes place in accordance with the equation

$$CH_4 + H_2O = CO + 3H_2 \text{——} 50.7 \text{ Cal.}$$

The yield of the operation, calculated from the ratio between the final calories and the sum of the initial calories and the calories supplied as heat was 77.3% on an average. It will be noted that the gas obtained contained a high percentage of hydrogen; it was diluted with distribution gas of which it reduced both the calorific value and the density.

Firedamp was really utilised for public distribution on March 27, 1950. A large collecting and transport grid has been projected in order to utilise firedamp from numerous pits in the Borinage and Centre coalfields. This grid is already well on its way to completion, and the Borinage and Centre coalfields yield, respectively, 60,000 and 120,000 cu.m. of gas daily. The gas, at the openings of the boreholes, has a calorific value of as much as 8,500 calories, is completely free from hydrogen sulphide, and contains a minimum of 90% of methane. Apparently it contains the gas helium in a proportion that is not negligible. The transport concern Distrigaz, which took the initiative in collecting the gas in the pits mentioned above, has ordered from the United States of America materials for the installation of the first plant for the cracking and re-forming of methane. This plant will be erected at the Ste. Aldegonde pit of the Charbonnages de Ressaix-Leval-Peronnes-Ste. Aldegonde-Genck. The plant, which will be started up a few weeks, will be able to treat 60,000 cu.m. of firedamp a day. The conversion will be carried out in carborundum tubes heated to 1,300°C. in the presence of a catalyst. If necessary, the addition of air and steam will prevent the deposition of fine carbon. This will be the first installation of its kind in Europe. While the plant is being completed the firedamp already collected by exhausters at 15 stations is not lost. At the centre stations it is mixed with coke oven gas, poor gas, and blast furnace gas in such proportions as to obtain a gas that can replace

normal gas. Part of the firedamp, mixed with air, is piped to certain industrial consumers, who state that they are delighted with this methanised air because of its perfectly constant composition and its calorific value. At the Borinage stations the firedamp collected is sent, as has been done at Frameries, to the Société Anonyme Carbonisation Centrale at Tertre, where the methane is at present used to the best advantage, either for heating the ovens, for cracking, or by mixing with water gas, producer gas, etc., in accordance with the needs of distribution and of the complex Carbonisation Centrale-Carbochimique. In any case, the calories of the methane are added to the calories of coal gas and other gases. Already, the firedamp mixed with coal gas and gas of lower calorific value, is transported beyond Brussels by the high pressure Distrigaz mains. The methane is introduced into the grid at 4,250 calories (450 B.Th.U.) by groups of compressors that raise the pressure of 2,000 to 3,000 mm. w.g. of the firedamp mains to the 3 to 5 atm. pressure of the grid. Firedamp has also been collected successfully in the Campine mines; since the beginning of last February, gas is being collected at the Winterslag mines. It can now be stated that conditions in a large number of Belgian mines are very favourable for collection. As the volume of methane evacuated daily from Belgian mines is estimated at 2 mill. cu.m. the interest of collection is evident, though it can only be applied in mines rich in firedamp. It should be stated that the utilisation of this new national source of thermal energy for the common good and in a record time is due to private initiative and capital. For a mine where firedamp is collected this constitutes an extra source of income. Further, it gives great advantages as regards the working conditions of the miners, since the air is much purer at the coal face and in the roads.

Underground Gasification

In Belgium, in view of the labour crisis that occurred after the country was liberated, the National Scientific Research Fund, founded by King Albert, subsidised a research syndicate to study underground gasification. The Belgian Government, the chief Belgian companies, the French mines, and also the Polish mines have since then considerably increased the funds available for experimental work. The general management of the work is assumed by a tri-partite International Committee, and its execution is the responsibility of the Belgian Socogaz concern. The experimental station is situated at Wandre, near Liége, the Bois-la-Dame centre of the Société Anonyme des Charbonnages de Bonne-Espérance, Batterie et Violette, in a coal mine that had been abandoned owing to the difficulty of extraction. The coal seam treated was situated between the —187 and —67 m. levels, and the volatile content was only 10.5%, which was a cause of inferiority.

During the tests it was found possible to produce, using cold air as a carburant, a poor gas of 800 to 1,000 calories that could be used as a source of energy for the generation of electricity. When using air enriched with oxygen the calorific value was increased to 1,200 calories, which was further increased to 2,000 calories by the injection of steam and oxygen. These special additions, however, were only used for fairly short periods.

Obviously, the conditions for the production of gas *in situ* are much more difficult to realise than in an ordinary producer. The reacting surfaces are much smaller for the same mass of coal, and lower temperatures increase the difficulty of reaction. The accumulation of ash, which cannot be reduced, tends to smother the fire, neglecting the fact that the fire, running along the coal face, tends, instead of remaining stable, to flare up and leave behind it unburnt fuel. Many problems remain of which the final solution becomes more complex and delicate as the control of various underground phenomena intervening in the operation is but partially realised. The gas industry, however, will only consider underground gasification interesting on condition that it can supply a gas of sufficiently high calorific value that does not contain too much inert matter and can be used to dilute a rich gas. This is not yet the case in Belgium, where the results so far obtained are insufficient to enable sufficiently accurate conclusions to be drawn regarding the best method of recuperating the residual energy of unexploited coal deposits.

Conclusion

In conclusion, I hope that my remarks will be of value both to your country and my own, and also to any other countries where the gas industry is now seeking new sources of gas. Certainly, in our own countries, it is logical that the coke oven should remain one of the chief means of producing gas, for coke is always the corner stone of our steel industries and should, therefore, be available in sufficient quantities in the country itself. But the Belgian gas industry, at present too closely connected with the coking and metallurgical industries, is in such a state of vassalage that it must try to break free. Submitted as it is, by its nature as a transforming industry, to all the upheavals, all the shocks that may occur in the market for power, it must guard against them. Taking normal evolution of things into account, it is agreed that in Belgium we have, or will have, supplementary sources deriving on the one hand from the gas from petroleum refineries, on the other from methane from coal mines rich in firedamp—valuable and important sources. Holding out a hand to the coal and petroleum industries, the gas industry will find in them valuable and abundant supplies that will enable it to benefit from the greatly enlarged and more adaptable supplies of town gas.

In what proportions will these various sources intervene in general and future distribution? It would be difficult to say at present. The future of each of the sources considered depends largely on the respective levels of the prices of the raw materials, coal, petroleum oils, natural gas, or refinery gas; also on the value of the by-products, such as coke and synthetic products, and on financial charges. And what is true today may not be true tomorrow.

DISCUSSION

Mr. E. Crowther (Chairman of the Northern Gas Board) said that M. Brabant had paid them a high compliment in presenting the paper, which gave them an opportunity of comparing their own difficulties and problems with those of another country. It was of the utmost interest to them to learn something of the work which was being done on the most recent developments, particularly in the matter of the employment of firedamp occluded in coal seams. With characteristic ability and energy the Belgians were making immediate and practical use of this latest development in technology which he hoped to see very soon copied in this country in those parts of the coalfields where the percentage of these gases was sufficient to warrant such a development. It appeared to him a most brilliant conception that a substance which hitherto had proved an expensive and dangerous nuisance should be exploited as a valuable fuel and as a means of appreciably diminishing the demands of the gas industry upon the coal resources of the country. There were a number of possible uses for such gases when collected, and he hoped that the National Coal Board would regard the gas industry as its natural and logical collaborator in putting any such gases as might be recovered to the greatest advantage in the national economy.

Oil Availability and Price

In Belgium, the close correspondence between the available quantity of this gas estimated to be available and the total quantity at present distributed to consumers was striking. The close relationship between the gas estimated to be available—although some of it might be in such small proportions as not to be worth recovery—and the total demand for gas of all kinds, appeared to be significant. The prospects of underground gassification, on the other hand, as a contributor to the requirements of the gas industry, appeared to him to be remote.

He gathered that M. Brabant and his colleagues were looking to other developments as a means of achieving their ends; but how far the gas industry could afford to make itself dependent on oil and oil products, in countries without indigenous supplies of oil, was a serious question, as it was apparent that many causes could seriously affect both the availability and the price of supplies in countries which had no supply of their own. At the same time, they could well appreciate the short-term advantages of the use of oil. It was as a result of a visit to a coke oven installation near to Brussels—a carbonisation installation as well maintained and operated as any he had seen in any country—that he asked the Coal Board to assist them over winter peaks during the past two years by the treatment of the coal charges to coke ovens with oil as a means of getting additional gas without additional capital expenditure for short-term peak periods.

An Impossible Situation

They could appreciate the disabilities which M. Brabant pointed out to them, which had emerged as a consequence of the extreme dependence of his country's gas industry upon coke oven gas, logical as it appeared to be after 1918 to re-establish the industry upon a coke oven basis. One had only to imagine the conditions of the coal and coke market which would obtain here if their gas requirements were met to any considerably greater extent than at present by carbonisation in coke ovens, many of them rich gas fired. In fact, the situation would be an impossible one.

It had been fortunate for them, as they saw by comparing and contrasting conditions in Belgium with their own, that they had retained a greater degree of flexibility in their plant and operations. They were apt to talk of flexibility in gas-making plant as if it simply connoted an ability to make more or less gas readily at will, but indeed flexibility in coke production was at least of equal importance and perhaps of greater commercial moment. They had in England been more fortunate and had succeeded in making the coke ovens partners rather than masters in their business.

This state of affairs was perhaps due to the fact that at no time had the total quantity of coke oven gas available to be purchased by the gas industry represented more than a fraction, although an important one, of their total demand over the country as a whole. It also appeared to be accepted that the essential condition for the construction of coke ovens, at least by interests other than those of the gas industry, was that they should have in sight either an actual or at least a provisional remunerative market for the coke to be produced. In any other circumstances, dependence upon such coke ovens for gas *i.e.*, independently owned coke ovens—might lead in time of economic difficulty either to severe restrictions upon gas supplies, as seemed to have been the case from time to time in Belgium, when ovens might be slowed down or even closed, or, alternatively, to the payment of altogether excessive prices for bulk supplies of coke oven gas if the ovens were to remain in full production.

Parallel Paths of Development

Mr. J. E. Davis (Chief Technical Officer, South Eastern Gas Board) said that it was most interesting to see the way in which the broad path of development over the past 50 years had been similar in the two countries, starting with small self-contained units each providing for the local needs of a community and developing into an integrated industry where production and distribution and sales and service tended to become the provinces of specialists.

It was true that in Belgium the gas industry had become far more greatly dependent upon the coking industry than it was in total in this country, where some 12% of all available gas was obtained from coke ovens not owned by the industry. That was the overall picture, but there were some areas in Great Britain where the position was much more nearly the same as in Belgium.

It was important to recognise how, in both countries, the function of the industry had changed. The small self-contained unit purchased selected coal of high quality, and was able to get it. Today the gas industry was seeking for sources of fuel gas to incorporate in its public supply and in this manner was extending its functions as the collector and distributor of gaseous fuels in the interests of overall fuel conservation.

The author referred to the increasing shortage of coking coals, but he (the speaker) was not sure whether this was the real point. What the gas industry needed was not so much a coal which on carbonisation would give a hard coke as a coal which, when carbonised, would give an adequate high yield of gaseous hydrocarbons. Surely it was 'fat' coals which the gas industry needed rather than coking coals. It was important to bear this fact in mind because, if the manufacture of coke were their main objective, much could be done by blending—a procedure which would be of materially less help in maintaining the yield of gaseous therms per ton.

Need for Greater Freedom

They needed greater freedom and greater variety in the choice of raw material, and yet coal must in one form or another be their main raw material. It was for this reason that he regretted the author's lack of enthusiasm, or possibly his view that there was a lack of enthusiasm in this country, for processes which would effect the complete gasification of a wide variety of coals. He thought it was recognised that methods established for the gasification of brown coals were not necessarily suited for the coals of Belgium and Great Britain, but that simply meant that they had to seek processes which were suitable.

The development which used methane extracted from coal mines was of great interest and possibly represented a source more likely to be of value to the gas industry in both countries than the efforts at underground gasification.

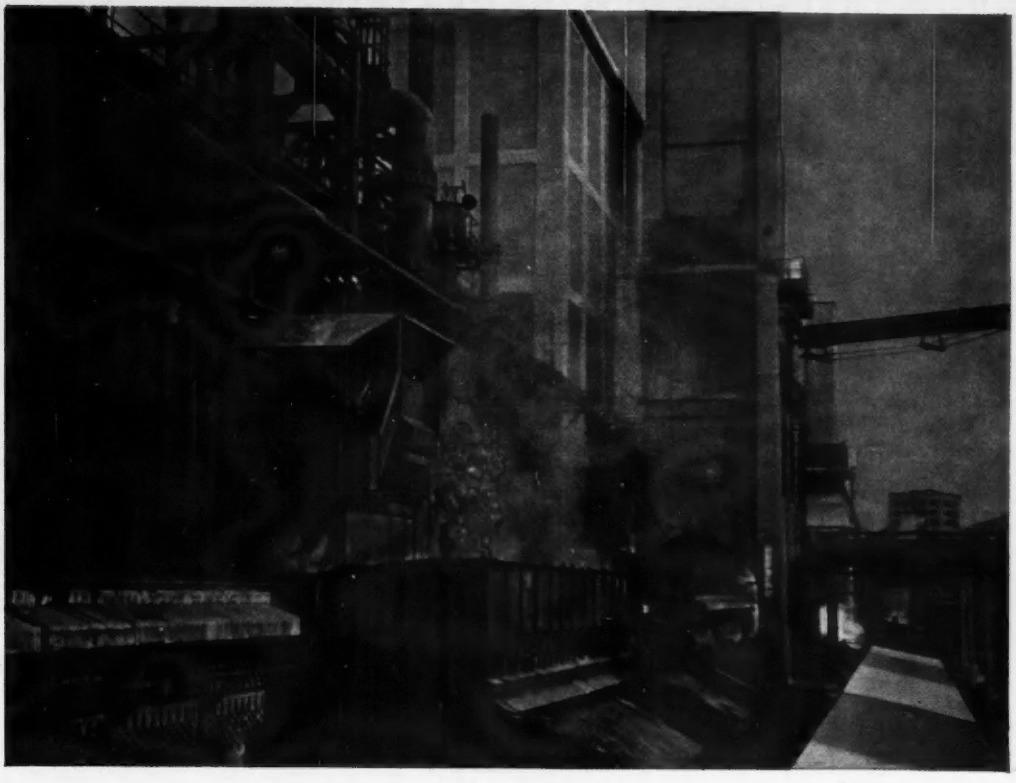
Under private enterprise 'risk capital' was attracted to ventures where there was a prospect of large and speedy gains. As the result of some successes and some failures industry progressed. There might well be a problem for nationalised industries in considering how to provide the equivalent of risk capital to ensure that they met the demands of the future as well as the demands of the present without spectacular failures, for a guaranteed rate of interest on invested capital would not, in itself, ensure the stability of an industry as an instrument of public service.

Progress Still Too Slow

Colonel W. M. Carr said that they had great opportunities of co-ordinating their fuel production and supplies by reason of the nationalised character of the industry. Many of them hoped that progress in co-ordination would be much more rapid than had so far proved to be the case. There was still a tendency to look upon what were the markets of the past as far as fuel supplies were concerned as being the markets of the future. As an example, he would stress the fact that the National Coal Board was still pressing the sale of domestic coal for burning in open hearths, which, in the long run, must be to the disadvantage of fuel supplies. It was to M. Brabant that one would express special thanks for so directly pointing out the danger which they had already appreciated of divided responsibility in gas supply. From his own experience, particularly in the West Riding of Yorkshire, he would say that it was essential that production and distribution should be co-ordinated under one control.

The difficulties which had been experienced of coke oven plants being operated from the point of view only of the economics of coke production, were common with those which had been experienced in Belgium. It was unfortunate that schemes of co-ordination envisaged before the war, as between the coal producer and the gas industry, and developed to the point of actually constructing plant, were today still in the air.

He referred to a scheme which the United Kingdom Gas Corporation had entered into with Dorman Long & Co. Under that scheme, the whole of the production of one colliery which was working a seam of coal was to be carbonised. It was true that metallurgical coke in the strictest sense of the word for steel production was not to be produced, but a coke which was very suitable for the markets which had been mainly supplied by gas undertakings was to be produced. It was sad that schemes of that sort, which one envisaged might be accelerated under nationalisation, remained in the air. There was a tendency for them still to be far too much in watertight compartments and not to appreciate that it was the economics of the public services, both domestic and industrial, which should be the primary consideration in all fuel problems.



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GAS MANUFACTURE IN NORTH THAMES*

By J. BURNS, G.M., B.Sc., Ph.D., M.Inst.Gas E.
Chief Engineer, North Thames Gas Board

THE major portion of the gas supplied by the North Thames Gas Board is manufactured in large centralised stations interlinked one with the other, and this fact alone distinguishes the practice of gas manufacture in the area from that of other area boards. The advent of nationalisation, however, may tend to encourage the centralisation of manufacture in other areas and a study of the methods and practice employed in the North Thames Gas Board may be of interest. It may be of interest too to discuss the conditions under which centralisation and interlinking are economic and the advantages offered by such centralisation. Obviously the fundamentals of gas manufacture practice are common to all systems interlinked or otherwise, but the methods of application can be very different.

J. BURNS.

Former Gas Light and Coke Company Grid

Approximately 85% of the gas in the area is manufactured in the stations of the former Gas Light and Coke Company, and the grid linking those stations and feeding the major portion of the area from Staines to Southend has been built up gradually throughout the period of the last 140 years. Manufacture has been centralised principally at the big riverside stations as a direct consequence of the cheap water transport facilities, with the principal station at Beckton, which now produces over 100 mill. cu.ft. per day of gas of a calorific value of 500 B.Th.U., or 30% of the area output.

This grid is based on Beckton, with the main arteries, in the shape of twin 48 in. mains, flowing westwards, linking up the stations at Bromley, Bow Common, Stratford, Nine Elms, Fulham, Kensal Green, Brentford, Southall, Harrow, and Staines to Uxbridge, while smaller arteries flow to the east to link up with Southend. These stations constituted the Gas Light and Coke Company system of manufacture, but nationalisation added manufacturing stations at Romford, Poplar, Lea Bridge, Mill Hill, Hornsey, Uxbridge, Slough, Maidenhead, High Wycombe, and Ascot, all of which, with the exception of Poplar, lie on the fringe of the former Gas Light and Coke Company district, and represent 15% of the output of the area as a whole.

Thus, one of the exercises that confronted the North Thames Gas Board on its formation was the study of the desirability or otherwise of linking all the stations to the existing grid, having behind it the accumulated experience of many years of grid operation.

There are two aspects to be considered in interlinking manufacturing stations—

(*a*) the benefits to be gained without any change in the amount of gas manufactured at each station throughout the system, and
(*b*) the benefits to be derived from increasing centralisation of gas manufacture as the load increases.

This study involves certain fundamental principles that may appear obvious, but are probably, nevertheless, worth setting out. The principal benefit to be obtained under (*a*) above is flexibility of operation allowing a greater margin of safety with lower charges for standby plant. It is difficult to determine the precise improvement in production costs that this benefit brings, but, where distances between stations are short, interlinking is well worth while.

It is, however, under consideration (*b*) above that the greatest benefits can be expected from interlinking manufacturing stations, and these benefits can be reasonably accurately predetermined.

The factors involved in the study of the best position to site new gas-making plant to produce gas most economically are:—

(1) Availability of labour.
(2) The cost of raw materials, and particularly the cost of coal into the station.
(3) The marketing costs associated with the sale of coke.
(4) The cost of laying mains from one station to another.
(5) The cost of pumping gas from one station to another.
(6) The capital, labour and general overhead requirements of the large manufacturing station compared with the small.

Quite obviously, the availability of labour is the most important factor in determining the site for expansion of manufacture, for without adequate labour all other factors are of no importance.

The cost of raw materials, and in particular the cost of coal, influences the cost of gas manufacture to a greater extent than any other single factor. It should be remembered that the technical efficiency of a manufacturing plant is, in the main, quite independent of its site, and one should not be misled by low gas production costs at a site receiving relatively expensive coal; the aim should be to develop the most technically efficient units at the site with the most favourable raw material costs.

In so far as coal is concerned each 1% increase in price means an increase of just over 2% in the cost of gas production, with all other costs remaining the same.

This factor is not so important as the cost of coal for the relative amounts involved are somewhere in the ratio of 5 to 2, and usually the difference in the marketing costs of coke at different stations in an area is not great. However, in preparing an estimate of production costs at two stations, it is wise to include the cost of coke transport from one station delivered to the other, for this will represent the very worst case.

It is difficult to lay down particular considerations on the cost of laying mains, for conditions vary so much from one site to another. The size of main to be chosen must, of course, be considered in the light of the possible developments of gas requirements, but it is always wise to overestimate the size rather than under-estimate, for gas mains may be expected to have a life, in some cases, of 80 years and longer, and we should have sufficient faith in the industry to expect progressive expansion. Too often now we have to re-lay existing mains before the end of their life because they are unable to carry the load we now require. The cost of laying a main does not increase proportionately to its size.

The cost of gas pumping is a function primarily of power costs on the works, and here again the calculation must depend on local conditions. The power requirements for gas pumping are described very fully in the memorandum entitled 'Gas Pumping Machinery,' by L. J. Clark, published by the Arrow Press in 1947.

It is possible to relate factors (2) to (5) inclusive, to distances between points of gas requirements, and this relationship is shown graphically in Fig. 1. In this, power costs are taken on the basis of a typical British Electricity Authority two-part tariff for industrial power in London. The costs of main-laying are based on current costs for laying mains in non-

* Abstract of I.G.E. Communication No. 385.

built-up areas, and the costs of coke transport are based on rail freight charges. The technical efficiency of gas manufacture and all other costs are assumed to be the same at each location.

Considering the above factors only, it is apparent from the relationship shown in Fig. 1 that the transmission of small quantities of gas up to 1 mill. cu.ft. per day is economic only over relatively short distances, 20 miles being the limit, with a 20s. differential in coal costs. At the other end of the scale, the transmission of 10 mill. cu.ft. per day is economic up to 60 miles, with a similar differential in the price of coal.

Superimposed upon the factors of gas transmission and coke transport costs, consideration has also to be given to the advantages in labour, general overheads and capital requirements of the large manufacturing station compared with the small. Labour requirements vary considerably with the type of plant installed, but it is considered that for the same type of plant the labour costs on a big station, of 30 mill. cu.ft. per day output and over, approximate to 80% of the labour costs on a small station of up to 5 mill. cu.ft. per day output. More particular savings are evident in capital costs of plant. In so far as coal gas plant is concerned the North Thames Gas Board at the present time accepts the 7.5 mill. cu.ft. per day unit as the most suitable size, either in vertical retort plants, intermittent chamber plants, or coke ovens. Capital costs of this size of unit compared with the unit of 1 mill. cu.ft. per day output are in the ratio of 100:145. The general overhead charges on the small station are approximately double those on the large station, and the total

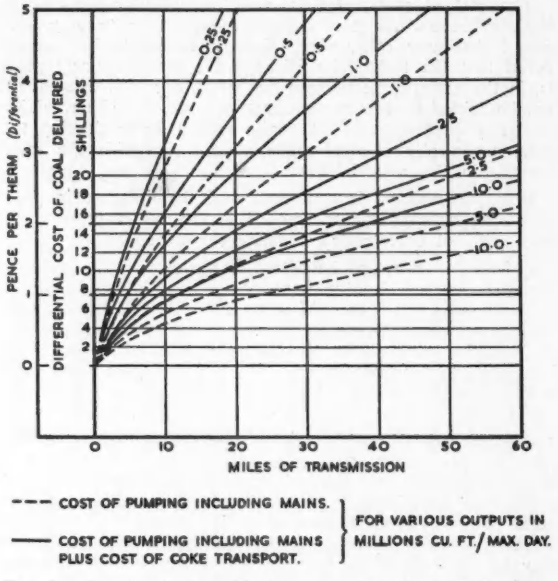

FIG. 1.—*Graph showing Variation in the Cost of Pumping Gas in Relation to Changes in the Differential Cost of Coal Delivered to the North Thames Gas Board.*

effect of these three factors is to show a saving of approximately 1.5d. per therm in favour of the big station. This is equivalent to a net price differential of 12s. per ton of coal, and this saving is a most important factor in determining the policy towards centralisation.

The full implications of factors (A) and (B) above were applied to all of the manufacturing stations vested in the North Thames Gas Board not connected to the former Gas Light and Coke Company grid, and as a result of this study it was decided to interlink all the manufacturing stations of the Board. Most of these stations are already connected up and work is proceeding on other schemes. This implies the possibility of an even greater centralisation of manufacture in the area than is obtained now, with the riverside stations, with their cheaper coal, growing at a faster rate than other stations, while on the basis of the above factors it may become economic to shut down some stations entirely.

At this stage we should ask ourselves whether it is wise to build huge stations with heavy concentrations of men and plant. There are some disadvantages, and perhaps the most apparent is the danger of the management losing that close personal contact with labour that has always been one of the characteristics of the gas industry. In this respect, the big station does require a very particular type of administration and management, with sectionalisation coupled with devolution of responsibility so that, from the administration point of view, it becomes in effect a series of inter-connected small stations at which the close personal contact between men and management can be retained under the overall authority of the station engineer.

In the author's opinion, the advantages of centralised manufacture far outweigh the disadvantages, and we should never be afraid of going ahead.

Operation of Interlinked System

The installed capacity of coal gas plant in the North Thames Gas Board area is 232 mill. cu.ft., with 136.5 mill. cu.ft. of carburetted water gas plant and 4.5 mill. cu.ft. of peak-load oil gas plant, giving a total of 374 mill. cu.ft. of mixed gas at 500 B.Th.U. Obviously, not all this plant is available at the same time, due to repair and maintenance, etc., but during the past winter the maximum demand on one day was 327 mill. cu.ft., and the minimum demand on the lowest day was 113 mill. cu.ft., with a consumption load factor of 61.4%.

It is recognised as the primary function of the engineering staff of the Board to have available to the public that amount of gas that it requires on any day of the year, and probably the greatest difficulty that the engineering staff has to overcome is the wide variation in demand from one season of the year to another. This variation is probably greater in the North Thames Gas Board area than in any other gas supply area, for the author believes it will be found that the North Thames Gas Board area has a lower load factor.

The successful management of large installations on wide variations of load demands forethought and forward planning, and, in fact, the degree of success is very much dependent on the degree of accuracy of pre-estimation of load requirements at any time of the year.

Two main factors have to be considered in determining the amount of gas to be sold on any day throughout the year—

(*a*) the level of gas demand;
(*b*) the atmospheric temperature.

(The relationship between gas demand and atmospheric temperature is a fascinating subject, and the development of our information on this matter has been fully described in the technical literature and especially in a paper by D. G. Rose.* It may be of interest, however, to describe how the gas engineer can apply this information to get more economic and efficient operation.)

If the daily gas consumptions for a year are plotted against the average atmospheric temperature for each day—and by average atmospheric temperature is meant the average of 24 readings taken each hour of the day—there is a relationship, but not a very precise one, and the relationship is of little value in forward estimating. This lack of precision is due to—

(*a*) the influence of the season of the year, for it is possible to have two days, one in June and the other in November or even January, with identical average atmospheric temperatures, but because of the seasonal influence the gas consumption will be very different; and
(*b*) the time lag that is necessary for the gas consumption to change with change in atmospheric temperature.

* Rose, D. G. A Background to Some Economic Problems in the Gas Industry. *Inst. Gas Eng. Comm. No.* 352/116.

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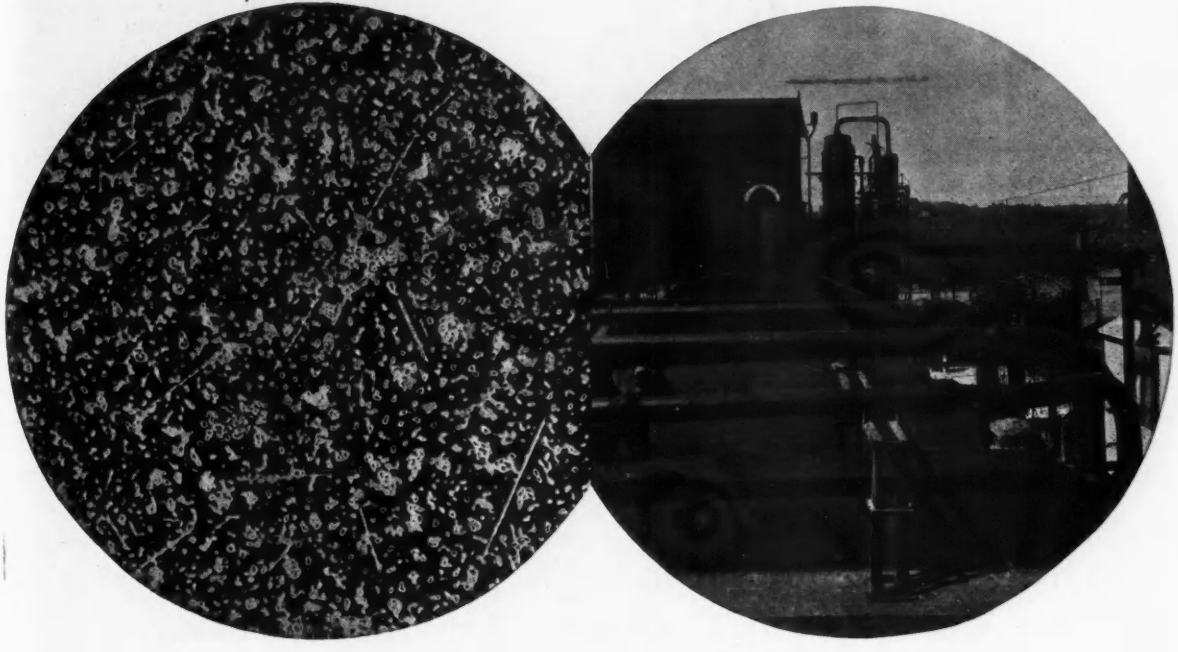

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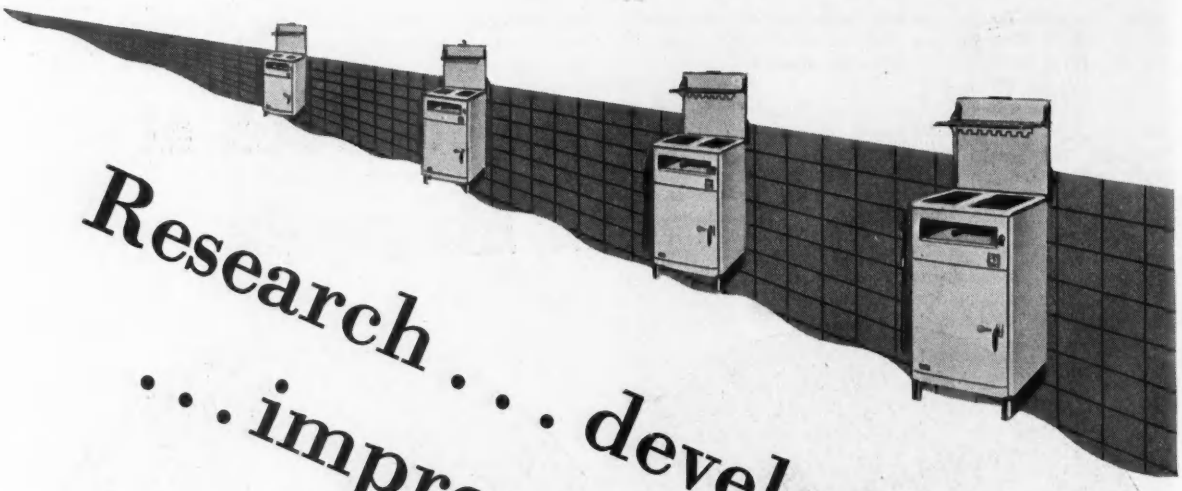

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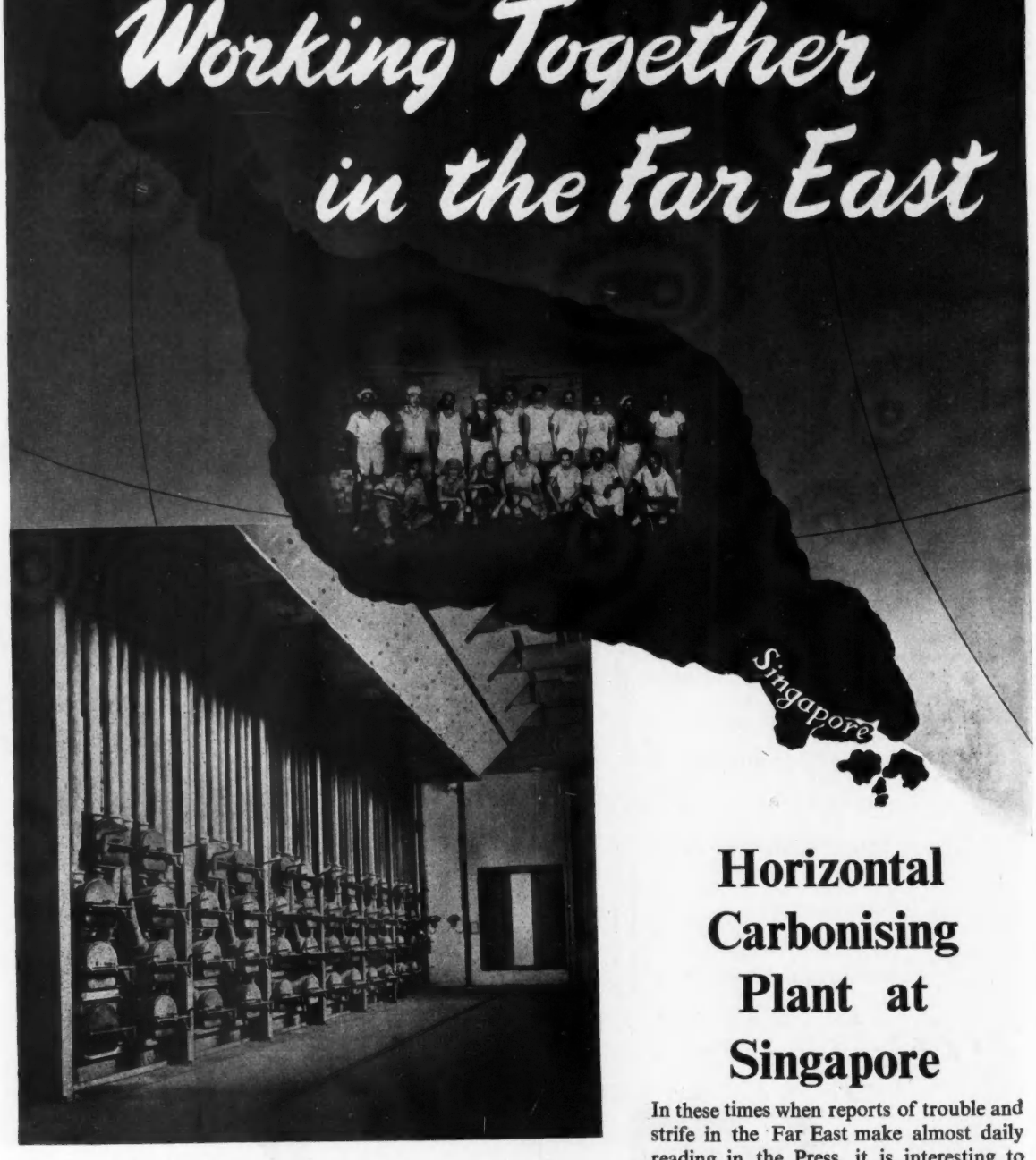
Working Together in the Far East



The original carbonising plant illustrated above consisted of six beds of eight horizontal retorts, which has now been extended by the addition of four similar beds.

Horizontal Carbonising Plant at Singapore

In these times when reports of trouble and strife in the Far East make almost daily reading in the Press, it is interesting to draw attention to an example of constructive and co-operative effort. The group photograph shows the Native Staff who worked under our supervision at the site.

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The discrepancy arising from the seasonal factor can be largely removed by taking into consideration the standard temperature, or temperature reasonably to be expected for each day of the year. This standard temperature in the case of the North Thames Gas Board area is the average of the average daily temperatures recorded at Fulham in the centre of the area over a period of 22 years, and corroborated by meteorological data extending over 100 years.

The discrepancy arising from time lag can be removed by taking into account the average temperature of the preceding 24 hr., as well as the average temperature of the day in question, and then, if the temperature so obtained is averaged with the seasonal or standard temperature, there is obtained an effective temperature that, when plotted against the gas consumptions throughout the year, shows a very precise relationship. The plottings fall within a narrow band through which a mean line can be drawn to represent the effective temperature-consumption relationship, and this is especially accurate between 40° and 60°F.

The first operational use of the temperature-consumption relationship is in the forward estimation of gas requirements for a day ahead. With experience, it is possible to use a graph to estimate accurately to ± 2%, and by close liaison with the weather forecasting experts it is possible to estimate quite accurately for three and four days ahead. The benefits of this in scheduling particular plants for work are apparent.

Clearly, any particular temperature-consumption relationship will only remain constant so long as there is no change in the level of consumption, but any change in the level of consumption is in most cases gradual, and the error introduced from one day to the next is not great. As a corollary, this temperature-consumption relationship is a very effective way of demonstrating the change in the level of demand,

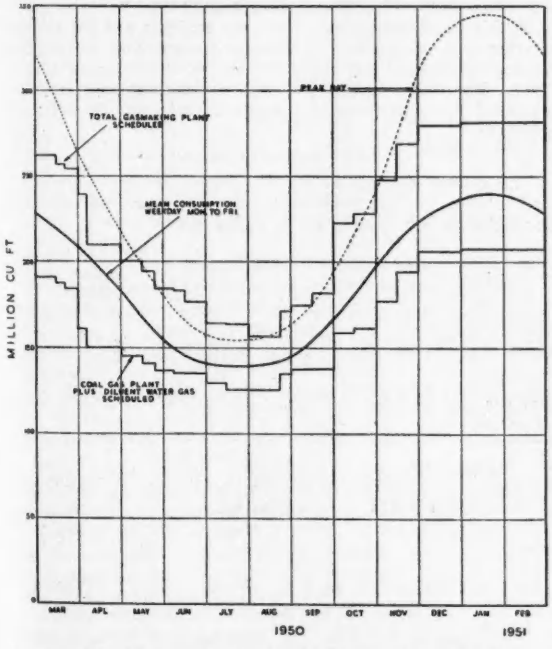

FIG. 2.—*Graph showing the North Thames Gas Board's Gas Production Programme, for* 1950-51, *in the area served by the former Gas Light and Coke Company.*

for, if the plottings fall consistently above the predetermined line, it indicates a greater average gas requirement per consumer, or an increase in the number of consumers, or both, and continuance of the tendency over a month or two gives the information necessary to strike a new relationship and draw a new graph.

It is most useful to know from one year to another what the real level of gas consumption is, quite apart from the variations in consumption introduced by abnormal weather conditions, and the consumption-temperature graph gives this, for it is possible to summate the consumptions for each day at its standard temperature and so obtain the annual consumption on standard temperature conditions.

The North Thames Gas Board uses the consumption for the year 1938 based on standard temperature conditions for comparison purposes, and if this be taken as 100 the corresponding consumption level now is approximately 130.

The next very important application of the temperature-consumption relationship is the preparation of schedules of plant required to meet the demand throughout the year. For this, the standard or normally-to-be-expected temperatures are set out day by day throughout the year, and the corresponding consumption at the appropriate load level plotted against them. This, if there were no variations from the standard temperature, would give the exact plant schedule required, but now the possibilities of abnormal temperatures occurring at any time throughout the year must be considered. The data from which the standard temperatures are derived also provide the upper and lower limits of abnormal temperatures occurring in the case of the North Thames area throughout the last 22 years, but obviously for plant preparation schedules we are only interested in the lower limits.

Fig. 2 sets out a typical plant schedule, showing the line of consumption on standard temperatures, possible consumption at abnormally low temperatures, and the step-wise introduction of coal gas and water gas plant to meet these conditions. It should be made quite clear that this method of assessment indicates only the magnitude of extreme temperature peak, which can be met at any time of the year, but it does not indicate the number of consecutive days over which this peak could operate. Knowledge of this is an added refinement in plant scheduling and will be dealt with below.

This general approach to plant scheduling is of outstanding value to the engineer, for with it he can accurately predetermine his programme of repairs and maintenance, making the most economic use of his plant in the process and holding the minimum amount of plant under expensive standby conditions.

From plant scheduling to the preparation of estimates for raw materials, by-products, labour, and stores, etc., is a short step, and, in practice, estimates based on this foundation have been found to be very accurate.

Control Room

All this work of estimation of consumption and preparation of schedules can advantageously be carried out in a central control room, which is, in the case of the North Thames Gas Board, situated at the chief engineer's headquarters. The control room directs also the distribution of gas throughout the 300 miles of mains comprising the grid, and controls the operation of approximately 100 gas pumps situated at works and holder stations.

It is perhaps worth while setting down the functions of the control room and its officers more precisely, to crystallise the general functions set down above. They are as follows:—

Short Term

(1) To determine each day the gas demand for the ensuing 24 hr. ending 06.00 hr.

(2) To arrange with stations their contribution of gas to meet the consumption, having regard to the gas stock position, the outlook for the next few days, and the operation of the most efficient and economical units of manufacturing plant.

(3) To direct the flow of gas through the grid from or

to gasholders at works or holder stations, according to the load, and to ensure equitable distribution of predetermined stocks.

(4) To accommodate such repairs as may become necessary to manufacturing plant from day to day.

(5) To direct the movement between stations of liquid fuel (oil, tar, etc.) for use on boilers.

(6) To act as liaison between manufacturing stations and by-products works in connection with the movement of crude products such as tar, liquor, benzole, etc.

(7) To act for the chief engineer at all times for the receipt of messages relating to gas production, unusual occurrences, etc., particularly outside normal office hours.

Long Term

(8) To estimate the seasonal gas consumption well in advance, and to collaborate with manufacturing stations in planning major repairs to both plant and gasholders; to prepare schedules of plant availability and operation for periods of six months or more ahead.

(9) From gas schedules to prepare estimates of raw material requirements of coal, gas oil, bog ore, etc., for purification, for submission to the appropriate departments for purchasing and supply.

(10) To prepare, also, for submission to the coke manager and controller of by-products, respectively, estimates of residual production of coke and breeze, and of crude tar, ammoniacal liquor and benzole in order to provide information for marketing and treatment.

(11) The estimation of the probable future trend of load and demand for gas, to provide a basis on which decisions can be based for recommendations for new manufacturing plant.

Gas Manufacturing Plant

Variability of load has been the main theme of this discussion on gas demand so far, and it is well now to look at the different types of gas-manufacuring plant that the gas engineer has at his disposal.

The three main types are coal gas plant, carburetted water gas plant, and peak-load oil gas plant. These three types of plant have very different economic characteristics. Above all, they differ widely in capital costs and operating costs, and it is proper now to look at the length of time that it is most suitable for each type of plant to operate throughout the year to give the most economic operation.

It should be mentioned here that it is the policy of the Board to operate coal gas plants essentially as base load plants, and once a plant is put to work it should operate on a more or less constant schedule of production throughout. The variations in load demanded from day to day, due to variations in temperature, are taken by the more flexible carburetted water gas plant and by the peak load plant. In this consideration of the length of time that it is economic for a plant to operate, we are helped again by the temperature-consumption relationship referred to above. If the standard temperature-consumption points for every day of the year are plotted, and plotted in ascending order, we get a single-line chart of consumption against days of operation per annum, and we get, thus, a measure of the number of days on which a specific load has to be met. Fig. 3 sets out a typical single-line chart of this relationship for the Board for the year 1950. It will, of course, be appreciated that there is a different line for each load level. The line is drawn to indicate conditions to be expected in a normal or standard year, but provision can be made for the abnormally cold year and the abnormally mild year. This chart, above all, pin-points the extreme peak load.

The capital costs of various types of plant are set out in the accompanying table. These include the capital costs of all ancillary units of plant properly apportioned to make up a complete gasworks, in each case, and are set out on the basis of a capacity of 1 mill. cu.ft. per day, but relate to units of plant of 5 to 7.5 mill. cu.ft. capacity per day.

(A) Operating Costs

Total direct charges associated with the three types of plant are as follows:—

	Pence per Therm
Coal gas	6.6
Carburetted water gas	8.309
Peak-load oil gas	10.633

(Calorific value = 500 B.Th.U. per cu.ft.)

In this the direct charges taken for coal gas are the average charges for coke oven, continuous vertical and intermittent vertical plant, and the prices are the prices ruling in March, 1951. The charges associated with the carburetted water gas plant relate to mechanically operated grate sets of 8 ft. dia. generators.

(B) Capital Charges

The capital charges at the expected rates of depreciation and interest for the three types of plant, based on operation for 365 days per annum, are as follows:—

	Pence per Therm
Coal gas	1.46
Carburetted water gas	0.80
Peak-load oil gas	0.28

(Calorific value = 500 B.Th.U. per cu.ft.)

Costs of Carbonising Plant and Ancillary Plant per mill. cu.ft. of gas per day (in March, 1950). (Based on Plants of 5 to 7.5 mill. cu.ft. of gas per day).

	Carbonising Plant Complete with Building, but Excluding Coal and Coke Handling Plant	Ancillary Plant up to Outlet of Purifiers, together with Coal and Coke Handling Plant	Extra for Gasholders, Dri-Gas Plant, Boosters, Boilers, Roads, Sulphur-recovery Plant, Lobbies and Workshops, etc.	Total Costs
1	2	3	4	5
Coke ovens, complete with producer plant ...	£78,000	£94,000	£52,000	£224,000
Intermittent vertical retorts (two benches)	£88,000	£86,000	£52,000	£226,000
Continuous vertical retorts (two benches)	£88,000	£86,000	£52,000	£226,000
Horizontal retorts	£70,000	£86,000	£52,000	£208,000
Carburetted water gas plant	£53,000	£41,000	£30,000	£124,000
Oil gasification plant	£5,200	£11,200	£18,000	£34,400

Obviously, the capital charges per therm increase as the number of days of operation per annum decrease, and it is possible to strike a balance between operating costs and capital costs to determine the best type of plant to install for gas loads depicted in Fig. 3. This relationship is shown graphically in Fig. 4, and from it we learn that it is not economic to install coal gas plant to deal with increments of load that occur for some 130 days per annum or less. The load for this is more economically taken by the carburetted water gas plant and peak load plant, and on the

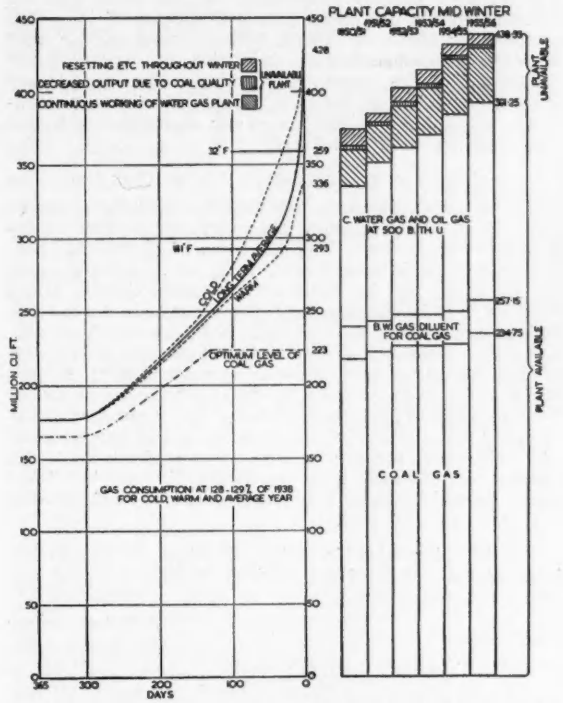

FIG. 3.—*Graph showing Estimated Gas Production by the North Thames Gas Board between* 1950 *and* 1956.

basis of costs only the peak load plant is economic for dealing with increments of load that occur for approximately 110 days and less per annum; but in the case of peak load plant, care must be taken that the proportion of peak load gas is not so high as to impair seriously the combustion characteristics of the mixed gas on the district. In the case of the peak load oil plant installed at the Board's Southend works the amount of oil gas that can be mixed is in the region of 20% along with equal mixtures of coal gas and water gas.

This points to the desirability of the development of a peak-load gas process with low capital costs and in which the combustion characteristics are similar to those of coal gas or carburetted water gas, or, alternatively, the development of more flexible gas appliances. From these considerations it is possible to determine the optimum level of installed coal gas, water gas, and peak load gas plant, and to determine the load factor on each. In the case of coal gas this load factor is approximately 85%, leaving 15% available for re-setting and other repairs. It so happens under present conditions of speed of getting work done that this 15% is about right, and coal gas plant is either at work or under repair, and does not require to stand idle for any length of time.

It is useful to plot alongside the single line chart the build-up of new plant over the next few years, so that one can see at a glance if the correct ratios of the different types of plant are being maintained. The Board's programme for the next few years is illustrated diagrammatically in Fig. 3.

(c) Coal Gas Plant

The trend now in coal gas plant is towards placing greater emphasis on better working conditions for labour and on better amenities in its neighbourhood. The choice of any particular type of coal gas plant is probably dictated principally by—

(i) operating conditions for men,
(ii) amenities in its neighbourhood,
(iii) the type of coal available,
(iv) the combustibility of the coke produced, and
(v) the economics of operation.

There is little to choose between the coke ovens and the continuous vertical retort plant for operating conditions for men, and these probably represent the best conditions. The horizontal retort plant falls below the standard now expected in a modern installation. So far as amenities in its neighbourhood are concerned any static carbonising unit is at a disadvantage over the continuous vertical unit, because of wet quenching and hot charging and discharging. The disadvantages of wet quenching can be avoided by the introduction of the dry quenching system, provided always the dry quenching system is associated with adequate dust extraction. The continuous vertical retort system lends itself most easily to nuisance prevention as it is a simpler matter to apply dust extraction to these units than to any others, while the hot charging is totally enclosed and the coke is quenched inside the retort. Very considerable advances have been made in the mitigation of the dust nuisance, and it is possible now to apply successful dust extraction processes to coke discharging on continuous vertical plants and, to a lesser extent, to coke screening operations.

It has been considered that the continuous vertical retort is more selective in the type of coal it requires, but improvements in design are steadily removing any difficulties in this direction. The Board has the advantage of the long experience of the former Gas Light and Coke Company in the carbonisation of Durham, Yorkshire, and Midland coals on

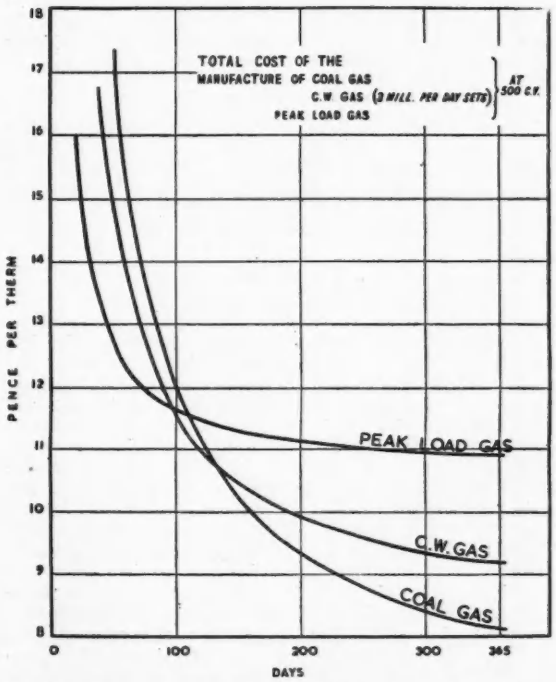

FIG. 4.—*Graph showing the Relationship in the North Thames Gas Board Area between Total Costs of Producing Straight Coal Gas, Carburetted Water Gas, and Peak Load Gas.*

both the oval and rectangular type of vertical retort, and now the type of coal available is no longer a factor influencing the selection of this type of plant. Developments in design, which were dealt with in a previous paper to the Institution,* are still proceeding, and the introduction of minor axis taper on the rectangular retort has improved coal travel, even on Durham run-of-mine coal. The latest rectangular type of retort, at present under construction on the Board's station at Kensal Green, will have major as well as minor axis taper, and it is hoped this will give even better results with the more difficult coals.

The quality of coke, and by this is meant the particular property of combustibility arising from the method of carbonisation, has been and in some cases still is a factor in the selection of a particular type of carbonising plant. But here, again, developments, in this instance on the coke burning appliance side, are helping to remove this factor. It is recognised that all coke, irrespective of the type of carbonising plant, should be properly de-breezed and adequately sized by screening and, given this, no difficulties need be associated with variations in combustibility when coke is used on large industrial installations and on large domestic appliances. The smaller domestic appliances have not yet the flexibility necessary to burn successfully any type of coke, and there are particular difficulties in the change-over from one type of coke to another. There have been great advances in the design of the small domestic coke burning appliances since their inception, and these improvements will no doubt continue and eventually coke combustibility as a factor in the selection of carbonising plant will probably disappear.

There remains for consideration that very important factor the economics of operation, and although quite accurate data are available for the economics of operation of the various types of plant as they are worked in the Board, it is not at all certain that each type would occupy the same relative position under different conditions of operation. It is perhaps sufficient to say that from the economic point of view there is room for both the static and the continuous type of plant, and the Board will probably continue to take advantage of the high gas-making efficiency of the static type of carbonising plant and continue to take advantage, also, of the higher overall thermal efficiency of the continuous vertical type.

(D) Carburetted Water Gas Plant

True to the general principle that improvements in design become apparent more quickly in the unit of lower capital cost, improvements in the carburetted water gas plant have been both rapid and beneficial. The automatically operated sets are now accepted as standard, and it is proposed to deal with only two aspects of improvement in the design of such plant—

(*a*) the dry sealed grate, and
(*b*) the plant of very large capacity.

The Board has had some years of experience with the dry-sealed grate, for the first plant so fitted was erected at the Brentford works of the former Gas Light and Coke Company in 1931, and the outstanding benefit that can be obtained from this type of grate is the much increased output from a generator of given size. As an example of this, a generator of 8 ft. dia., fitted with a dry sealed grate, can give an output of 3.75 to 4 mill. cu.ft. per day of 500 B.Th.U. gas, against an output of 2.5 to 3 mill. cu.ft. per day from a generator of 7 ft. 7 in. dia., fitted with a wet sealed grate.

This is a function of the higher blast pressure that can be worked with the dry seal, with which it is possible to work up to pressures of 50 in. W.G. for carburetted water gas manufacture, and even higher for blue water gas manufacture, compared with 30 in. W.G., which is usually the designed maximum on the water sealed grate. Obviously, the ancillary plant, including all mains connections on the dry sealed generator, must be of adequate size to handle the bigger volumetric output, but even with this the capital costs per therm are less on the dry sealed plant. The efficiency of operation is as high as that of the best type of water sealed grate of which the Board has experience. The dry sealed plant has been in operation now sufficiently long for the Board to have obtained an accurate comparison of repair and maintenance costs between it and the water sealed plant, and these, also, show an advantage, the comparative repair and maintenance costs being in the ratio of 100:125 in favour of the dry sealed plant.

A word of warning is necessary in connection with the operation of the dry sealed grate and the use of high blast pressure, for unless the balance between steam and air input is properly maintained there is a risk of heavy clinker formation. In this respect it is perhaps more critical than the water sealed plant, but once the method of correct operation is established there are no greater operational difficulties than with the water sealed plant.

(E) The Large Carburetted Water Gas Unit

Capital costs are such an important item now in the overall economy of gas production that every means must be explored to reduce them. The usual size of carburetted water gas plant ranges between 2 and 3 mill. cu.ft. per day capacity per generator, but the Board at the present time is having constructed at its Beckton and Southall works plants that are designed to produce up to 6 mill. cu.ft. per day from each generator. There are, in fact, three different plants in course of erection—one at Beckton consisting of four generators, each designed to produce 4.5 mill. cu.ft. per day; another at Beckton, of three generators, each designed to produce 6 mill. cu.ft. per day, and a new plant at Southall with one generator of 6 mill. cu.ft. per day capacity. Plants of this very high capacity are probably only practicable in an interlinked system in which the output, though large in itself, is small relative to the total load.

The following table, in which all prices are comparable, indicates the benefit of the large unit from the capital cost point of view:—

	Capital Cost per Mill. cu.ft. per Day
Two × 3 mill. cu.ft. per day generators ...	£53,000
One × 6 mill. cu.ft. per day generator ...	£41,000

It is interesting to note that if the capital costs for the 6 mill. cu.ft. unit are applied to the balance between the coal gas plant and the carburetted water gas plant set out in Fig. 4, it becomes economic to install carburetted water gas plant for increments of load occurring for 140 days and less, compared with 130 days for the smaller sets.

All the plants now being installed in the North Thames Gas Board area are designed essentially for the gasification of gas oil, but all are capable of modification to the use of heavy oil should the necessity arise.

Purification

The trend in purification is towards labour saving and a greater mechanisation of the process. It is perhaps regrettable that the industry is still dependent essentially upon a solid material as a purification medium, but satisfactory processes of purification by a liquid medium have been very slow in development. The Board is interested in any form of liquid purification likely to prove successful, and is particularly interested in the liquid sodium carbonate process with vacuum distillation, but this process requires further development in the final sulphur-recovery stage to be generally applicable to the Board's works.

It does appear, therefore, that dry purification will be with us for some time, and our attention has been directed to methods of improving the mechanisation of this process. Up to the present, box changing operations have been carried out on a piecework basis, and so long as there was a sufficiency of labour the four box stream was satisfactory, and probably the best form was the overhead boxes with top storage floor and roof for the big stream. With the present shortage of

* Burns, J. and Weston, F.R. Some Phases in the Development of the Rectangular Type of Continuous Vertical Retort. *Inst. Gas Eng. Comm. No.* 359/166.

labour it is found advisable to spread the load of oxide changing, so that it becomes virtually a continuous operation, and to this end the Board is having constructed tower purifiers at some of its biggest works, for base-load coal gas. Tower purifiers are, however, not necessarily the most suitable for seasonal load operation, for which considerations of capital charges become important, and for the smaller coal gas streams, and for streams of up to 4 mill. cu.ft. of carburetted water gas, the most suitable form of purifier is considered to be the 12 ft. deep ground-level box in which the oxide can be charged and discharged by mechanical grabs, and, in order to spread the labour load evenly, five boxes are provided, one of which may be out of action for oxide changing.

This question of mechanisation is receiving attention in the design of the tower purifiers, and mechanical means are being incorporated for the tipping of the oxide-containing trays, to reduce manual labour.

Attention is also being given to the use of a completely mechanised system involving contra-flow of oxide and gas, but this is still in the early stage of development.

Steam and Power

The cost of providing steam and power on the gasworks represents a substantial proportion of the total direct charges associated with gas manufacture. In the case of the works in the North Thames Board area, the steam and power costs, excluding capital charges, vary from 2½% to 10% of the total direct costs of the works, and this wide variation is dependent upon several factors—

(*a*) the size of the works,

(*b*) the type of carbonising plant installed, and the extent to which waste heat recovery is practised.

(*c*) the extent to which coke breeze is used as a boiler fuel for supplementing the waste heat steam, and

(*d*) the degree to which the steam and power system has been co-ordinated and modernised.

In the case of the works with the lowest proportional power costs (*i.e.*, 2½% of the total), the carbonising plant consists of one large continuous vertical retort house, and although the fuel consumption of this unit is equivalent to less than 10% of the coal carbonised, the steam recovered from waste heat represents about 75% of the total requirements of the works, including power generation. Further, an examination of all the steam and power consuming plant and machinery on the works has shown that if all units were modernised, employing 'pass out' turbines for electricity generation, with replacement of all small steam, hydraulic, and pneumatic prime movers by electric motors, the works could be made self supporting on waste heat steam when operating at a steady load, and there would, in fact, be a surplus of electrical energy that could be exported to the public supply mains.

In the case of works equipped with static carbonising systems, the proportion of steam recoverable from waste heat is substantially lower. For horizontal retorts and intermittent vertical chambers the amount of waste heat steam varies between 50% and 65% of that obtained from continuous vertical retorts, while in the case of coke ovens it is impracticable to recover any waste heat steam from the flue gases, due to the efficient system of heat regeneration employed and to the loss of the sensible heat of the producer gas. For all such works, supplementary direct-fired steam is required, and it is in these boiler installations that substantial economies can usually be effected.

Fig. 3 has shown the variation in demand for gas during an average year, and it follows that for a works that is required to take up this variation of load the curve for steam demand will be similar in form to the gas load curve. There would, however, be a tendency during the light load season for the steam demand not to fall in direct proportion to the gas load, as part load running of prime movers and machines is usually accompanied by lower efficiencies, but to offset this effect during periods of peak gas demand in cold weather the steam load tends to rise disproportionately, due to the introduction of anti-freezing measures using steam.

The overall seasonal steam load, therefore, is not likely to have a better load factor than the gas demand, and if steam from waste heat is regarded as the base load the load factor of the supplementary direct fired steam is likely to be quite low.

The basic principles for selecting the most suitable and economic type of direct fired boiler plant to meet the load variations are generally similar to those that govern the selection of the gas making plant itself, and these point to a proportioning of highly efficient, but expensive, water tube boilers with mechanical stokers arranged for burning low priced coke breeze on the one hand, and relatively cheap shell type boilers equipped for burning liquid fuel on the other. The relative costs of coke breeze and oil tar per 10,000 lb. of steam raised are 300d. and 500d., respectively, at present prices, but the difference in the capital costs of the two types of boiler indicates that for dealing with the increments of load that occur for less than about 170 days per annum the simple oil-tar fired boiler is the most economical. Further, the labour requirements for operating oil-tar fired boilers are lower than with solid fuel, and this is a desirable feature for peak load plant.

This represents the case in its simplest form, and there are a number of additional factors to be considered, such as:—

(*a*) The balance between the amount of oil tar residue from the carburetted water gas plants and the demand for steam raising. If there should be insufficient oil tar available, supplementary fuel in the form of pitch creosote or heavy oil will be required, which will reduce slightly the proportion of steam that can most economically be raised from simple liquid-fuel fired boilers.

(*b*) The economic relationship between expensive breeze-burning boilers and the simple liquid-fuel fired boilers will depend upon local circumstances and the characteristics of the steam load. If a new works is being planned, then the principles set out above can be generally applied, but if an existing works is being modernised and the installation of breeze-burning water tube boilers being considered, it is likely that some shell boilers will already exist, and these can usually be converted to liquid fuel firing at low cost, thus giving some advantage to the latter when arriving at the economic balance between the two types of boiler.

(*c*) The selection will be affected by the size of the works and the proportion of waste heat steam recoverable. If the gross amount of make-up direct fired steam is small, two types of fuel fired boilers may not be justified.

(*d*) The advent of mechanical stokers for shell type boilers which are capable of burning breeze quite efficiently has increased the range of usefulness for such boilers on smaller works. In these cases one boiler installation comprising a proportion of mechanically fired breeze burning units with the remainder oil fired would provide the most economic arrangement. When comparing the smaller direct fired boiler installation of up to, say, 15,000 lb. per hr. capacity, the mechanically fired shell type boiler may offer considerable advantages over the water tube type boiler in respect of capital cost which may show a proportional difference as great as 1 to 3, and even allowing for the higher efficiency of the water tube boiler it is doubtful whether they can be justified on the smaller works. It is appreciated that the installation of an efficient soot blowing and dust removing plant is essential for any breeze burning boiler installation.

Electric Power

On the average gasworks the total demand for steam expressed in therms amounts to 4.5% to 6.5% of the therms in the coal carbonised, and this may rise much higher on inefficient works, whereas it can be shown that by complete electrification of all mechanical drives, and the use of turbo-generators exhausting low-pressure steam for all process purposes, the gross demand can be reduced to 3.0% to 3.5% of the thermal input of coal, and at the same time, in the case of a works with continuous vertical retorts, a proportion of the total electricity generated would be available for exporting to the electricity supply industry.

It has been the practice in the North Thames Gas Board area to connect most of the works electric power systems to the public supply, and, in the case of those works that have not yet been completely modernised, a proportion of the power requirements is taken from the grid supply while internal generation is practised up to the economic limit. In order to operate the electrical system in this way it is necessary for the works generators to run in parallel with the grid supply, and in this direction the Board has so far received co-operation from the British Electricity Authority in permitting parallel operation of power supplies to all the larger works.

Many factors arise when considering the degree to which electrical generation on the gasworks is commercially expedient. It is clear that waste heat recovery should be exploited to the full and all possible electricity generated from this source, but, at the same time, it is very important to see that the amount of waste heat actually available is an absolute minimum.

In the works of the Board it is found that the demand for electricity varies from about 7 kWh per ton of coal carbonised in the case of the smaller works, up to 15 kWh per ton of coal carbonised on the larger works where more extensive mechanisation has been carried out.

It is estimated that in the future, with complete electrification of a works having the normal proportion of coal gas plant and carburetted water gas plant, the demand for power will be from 18 to 22 kWh per ton, and this would represent a charge of between 2s. and 3s. per ton of coal if purchased from the grid; this is a substantial proportion of the gas production costs.

In the case of works equipped with continuous vertical retorts and having a fuel consumption in the region of 10% to 12%, there is sufficient residual waste heat for raising the steam required to produce 25 kWh of electrical power per ton of coal carbonised and also supply all the needs of the process steam on a works producing gas with a calorific value of approximately 500 B.Th.U. If high-pressure waste heat boilers were employed (operating at 300 lb. per sq. in. and 600°F.) the amount of power generated could be raised to more than 30 kWh per ton of coal carbonised. It is, therefore, evident that in the case of such works it should be possible to generate more than the full internal requirements of the works after complete electrification.

The Gas Turbine

The advent of the gas turbine has introduced interesting possibilities for the direct conversion of waste heat into electrical energy. This type of machine is well suited to the temperature range of the waste gases leaving a continuous vertical retort setting, and by the installation of such a machine, in conjunction with a steam turbine for utilising the lower grade heat, the indications are that it should be possible to generate between 50 and 70 kWh per ton of coal carbonised.

It is appreciated that the capital cost of the gas turbine and associated equipment may be fairly high, for whereas the gas turbine and generator may cost only £36 per kW of installed capacity, the complete plant, including ducts, chimneys, housing, and other special modifications, may raise the total capital cost to more than £80 per kW. In spite of these charges, however, the overall cost of electricity generation is likely to be very favourable, for the capital charges amount to only 0.23d. per unit generated, while the running costs would be very low and should not exceed 0.1d. per unit.

If a gas turbine were installed on a works with one vertical retort house, it would be found that the electrical output obtained would be considerably higher than the works requirements. The most obvious means of utilising this surplus power would be to export it to the British Electricity Authority's grid system, and the value of that power to the Electricity Authority should be at least equivalent to the value of the fuel saved at the power stations. In 1949-50 the average cost of fuel per unit generated was 0.38d. per unit, and in the most efficient stations this may have been as low as 0.25d. per unit.

It is, therefore, evident that the low generating costs at the gasworks employing the gas turbine for waste heat recovery would be worth while from the point of view of the fuel saved in the power station boiler house. There are, of course, technical problems associated with the distribution system when considering the export of electricity from a works, and if such means of using surplus power were not acceptable there are other interesting possibilities. One of these would be to utilise the surplus electricity, after rectification to D.C., for the electrolysis of water into hydrogen and oxygen. In this way 1 kWh would produce 7.5 cu.ft. of hydrogen and 3.7 cu.ft. of oxygen. The oxygen could be used with steam for the manufacture of high grade producer gas with a calorific value of 300 B.Th.U., consuming in the process 0.6 lb. of coke and 0.5 lb. of steam, and yielding a total of 0.09 therm of producer gas and hydrogen per kWh.

Cost of Producing Electricity

Although the cost of producing electricity with a gas turbine is given above as 0.33d. per unit, the operating labour charges can be discounted when considering the marginal costs of the surplus electricity, as those charges will have to be met in any case, whether generation be performed by means of a gas turbine or steam turbine. If, therefore, the cost is taken on the capital charges only at 0.23d. per unit, the cost of fuel and energy used to produce the hydrogen and producer gas would amount to approximately 5d. per therm.

Another interesting possibility would be to make use of the surplus electrical energy for the production of oxygen by the liquefaction process, and in this way some 50 cu.ft. of oxygen could be produced per kWh. This oxygen could then be utilised in the manufacture of high grade producer gas yielding 0.9 therm per kWh, and consuming 8.0 lb. of coke and 6.5 lb. of steam. In this case the combined operating costs for power and coke could amount to about 3.6d. per therm. This process would also yield large volumes of nitrogen, which would serve as a very useful inert gas for the various purging operations that are now current practice on the gasworks. With reference to the steam requirements for the production of high grade producer gas, the waste heat gas turbine is capable of producing sufficient low pressure steam, in addition to the electrical energy referred to above, to supply the needs of the carbonising plant and the oxygen-consuming gas producers.

It would, therefore, appear that the application of the gas turbine for waste-heat recovery from continuous vertical retorts offers interesting possibilities, and, if this is not looking too far head, the waste heat turbines working in association with our well tried carbonising process might serve as the link, through the medium of hydrogen and oxygen production, for the development of the processes for the hydrogenation of coal which have already been developed by the Gas Research Board on the laboratory and pilot plant scales.

The carburetted water gas plant presents an interesting case for co-ordinating the steam and power requirements. By utilising high-pressure waste heat boilers, back pressure turbines for providing power, and steam accumulators for

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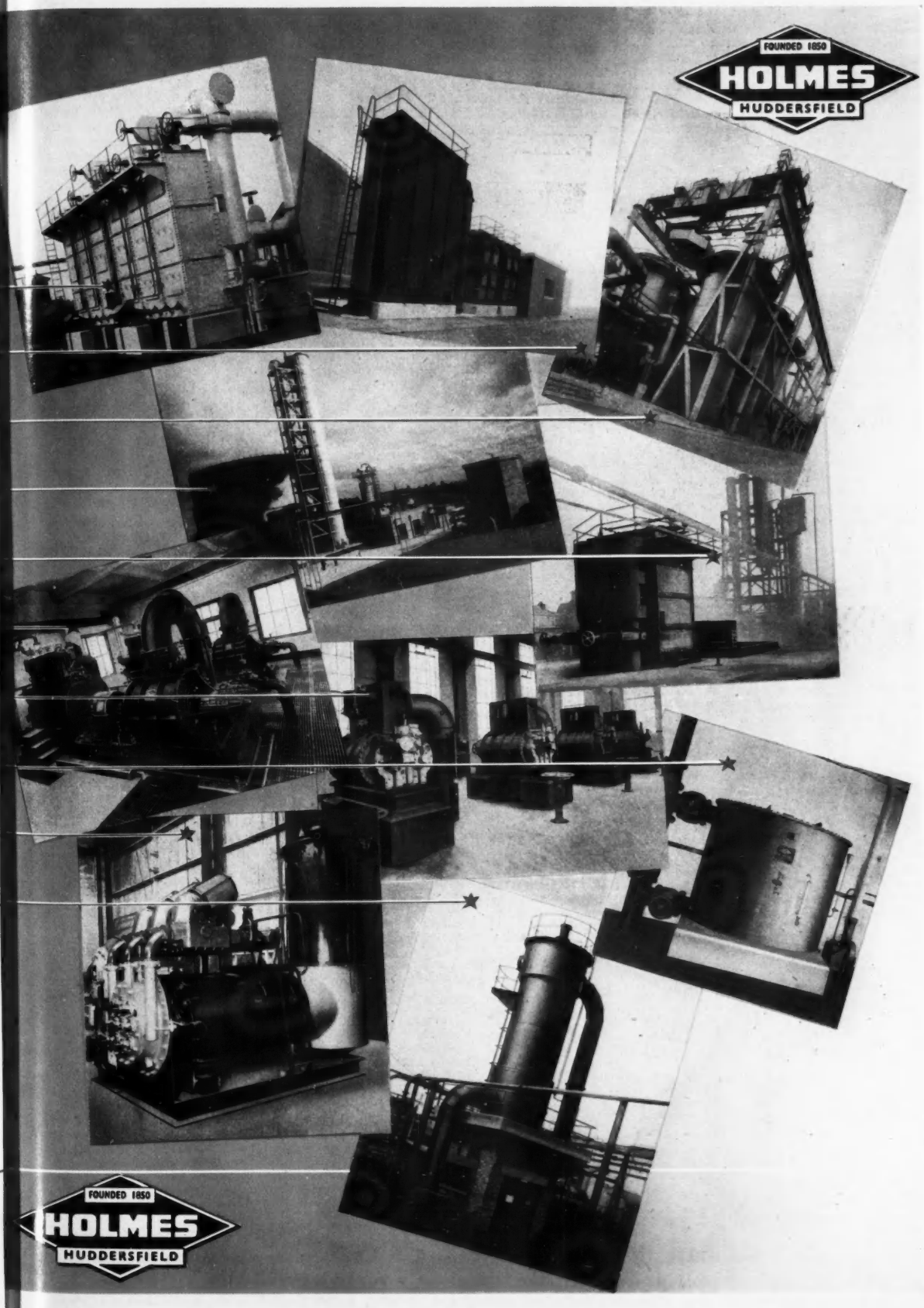
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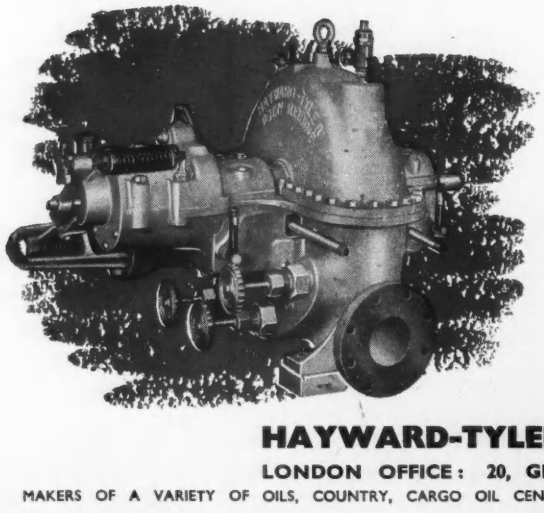

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balancing the low pressure steam requirements, the plants should be made completely self sufficient in steam and power, and in the case of the larger units, such as the North Thames Gas Board is installing at Beckton, which justify a 'pass out' steam turbo-generator set, a surplus of electrical energy should be available for exporting to the works system. More complete details of the operation of the steam system on the large new 18 mill. cu.ft. per day plant at Beckton will be available when this plant goes into operation in the autumn of this year.

Staff

The highly concentrated and essentially interlinked system of manufacture requires a particular type of staff organisation to operate it. The fundamental principle of successful operation is that each member of the staff should have devolved upon him a clear-cut responsibility for a specific section of the operation, with the recognition by each member of the staff that the sum total of all operations leads to the supply of that amount of gas that the public requires as economically as possible.

One of the benefits of the interlinked system is that the proportion of standby plant, including holders, can be substantially reduced, but this throws a greater responsibility on the staff operating the system to maintain a high standard of reliability and to adhere closely to a predetermined schedule. This, in itself, calls for individuality and the ability to take responsibility, and in so far as each member's successes or failures may affect his fellows he must be able to work as a member of a team.

DISCUSSION

Professor A. L. Roberts (Leeds University) said that the pioneering developments made by the former Gas Light and Coke Company in building up their extensive grid system had brought a wealth of knowledge and experience which would be of the utmost value to other areas in the future. In many respects the North Thames Gas Board was much more fortunate than most of the other boards in having inherited this major grid. In several of the other areas partial interlinking of the larger stations had been achieved prior to nationalisation, and as full an integration as possible throughout each area was obviously the ultimate ideal.

He would like to comment on the paper as a whole from the point of view of one concerned with the training of graduates for entry in the gas industry. As Dr. Burns said, the principles of gas manufacture were common to all systems whether interlinked or not, and one of their prime concerns at the University of Leeds was to see the students received a sound grasp of those principles. For the more practical details, however, they were materially dependent upon the knowledge provided by authorities of long experience in the industry, and it was in this connection especially that he felt that Dr. Burns' paper was of such value. Today it was essential to ensure that the student was not only soundly trained in the principles of gas manufacture and utilisation, but that he was also given some knowledge of the economic factors leading to the best choice of plant under particular conditions; and he must also be prepared to understand what would be involved in the interlinking which was likely to be achieved on a far greater scale than formerly.

Initiative and ability to accept responsibility were invaluable assets which must be sought out and encouraged during the students' training period. In his experience such qualities were often found in students who, although sound, were not brilliant academically, and that men of that type frequently proved when they enter industry to have the qualities that Dr. Burns specified to a greater degree than might be inferred from their academic attainments. This did not mean that the more brilliant men were lacking in these qualities; it was rather that the more average man might have compensating assets sufficiently to make him still of undoubted value to industry. In their long record of past students it was remarkable to see how many men of this type had attained positions of high responsibility.

In the recent reorganisation of the degree courses at Leeds they found it highly desirable to cater for this class of man, and this had been done by means of a three year's degree course entitled 'General Fuel Science.' In this the student was given a wide and general instruction in pure and applied science, the latter comprising fuel technology and its allied subjects. The four years' honours courses were reserved for students who by ability and intention preferred to go more deeply into the specialised sides of fuel, such as gas engineering. As a result of special support received from the University Grants Committee, they were now in a position to make extended provision for a third category of student—namely, men with a first degree in pure science or engineering who spent one or two years' post-graduate study in gas engineering or other fuel subjects. In these ways it was hoped that the Fuel Department at Leeds would be able to produce yet more men for the industry with the qualities that Dr. Burns desired.

Mr. T. C. Finlayson (Woodall-Duckham Company) remarked that it was only when one had read through Dr. Burns' paper two or three times that one realised how packed it was with facts based on the experience gained in his undertaking. As an example of the author's compact method of presentation, one might perhaps mention that in one part he brought out in half a dozen lines one of the basic advantages in gas manufacturing practice which had followed nationalisation of the gas industry—namely, that increased size of manufacturing unit reduced the labour charges, the capital costs, and the general overhead charges of a works. The average size of gas-making units now under construction was three times as large as the units being built before nationalisation.

He was particularly interested in the table showing comparative costs of gas-making plant per million cu.ft. of gas per day. Presumably, in view of the author's association with the North Thames Gas Board, the figures relating to coal carbonisation plant implied the use of Durham run-of-mine coal making 500 B.Th.U. gas. In this case it might be of interest to record that, whereas the capital cost of the coke ovens or intermittent vertical chambers was not much influenced by type or grade of coal, the capital cost of the continuous vertical retort plant per million cu.ft. of gas made might be reduced by as much as 15% by the substitution of, say, Yorkshire nut coal in place of Durham run-of-mine coal.

Cost of Amenities

Dr. Burns mentioned the great importance of improved amenities in the neighbourhood and improved operating conditions for the men. Both these features were highly desirable, but it must be remembered that it was very difficult to calculate a financial value for such improvements and that at the present time of high capital costs most careful collaboration was needed between gas undertaking and plant designer to see that such improvements did not increase the capital costs of a plant to an uneconomic figure.

The author showed the overall lower capital cost of a carburetted water gas plant compared with any form of carbonising plant. This was, of course, unanswerable, but it must be remembered that the water gas plant had the advantage of starting its process of gas manufacture using a residue from a carbonising plant and did not carry its proportion of cost in tar, ammonia, and sulphur removal from the original coal. In other words, capital costs shown in the table were only correct so long as the carburetted water gas plant enjoyed the advantage of being on a works where there was already a carbonising plant.

He was particularly interested in the author's reference to sulphur recovery plant and puzzled why a million cu.ft. of gas, however made, should involve the expenditure of £52,000 a million when the gas was made from a carbonising plant, and only £18,000 a million when made from an oil gasification plant. He was intrigued with the capital costs of the oil gasification plant, and would ask Dr. Burns whether the sum of £26,000 would be sufficient to build a 5 mill. cu.ft. per day plant complete with any necessary buildings and all apparatus associated with manufacture, the plant being designed with sufficient spares to enable it to provide a continuous output with the same reliability as a carbonising plant.

Dealing with selection of coal gas plant, it would seem that there was a sixth special feature which was implied in the text of the paper, but not specially mentioned—namely, fuel economy, which was a rather different thing from economics of operation. The author showed the very low net fuel consumption which could be obtained on modern forms of carbonising plant carefully integrated with a proper steam

and power balance. In these circumstances, the unexpected fact emerges that a modern non-recuperative continuous vertical retort plant with suitable arrangement of steam balance gave an even lower net fuel consumption than the modern fully regenerative coke oven plant.

The author referred to the slowness in development of a satisfactory process of liquid purification. This, of course, did not imply that there had been a lack of expenditure in development work directed towards the solution of this problem, and, in fact, a great deal of money had been spent in America, Germany, and in this country. Purification by standard oxide boxes had certain definite advantages. First, the process was very reliable in purifying gas to British standards; secondly, there were practically no effluents; and thirdly, there was the minimum of corrosion. Many processes of liquid purification had failed on one of these three points—namely, unreliability, the problem of effluent disposal, and the problem of corrosion. It was suggested that every new process should be judged on these points. It was gratifying to hear from Dr. Burns of his continued interest in this subject.

Major Issuses

Mr. J. H. Dyde, M.SC. (President Elect) said he agreed entirely with the factors listed by the author that have to be studied to decide on the best position to site new gas-making plant, but he would add availability of water supplies and disposal of effluent. In some inland areas these were major issues. He would not put availability of labour as a first consideration. True, the labour position was difficult now almost everywhere, but it could easily change. He had an idea that it did not influence the founders of Beckton, and they built a colony for their workers. He agreed with the fundamental importance on gas cost of the cost of raw materials to site, particularly coal, and the fact that waterborne coal by one's own fleet had become progressively more favourable than rail haulage. The long life of gas mains and the increased mechanisation employed in laying were tending, despite increase in cost of mains proper, to make it more profitable than hitherto to transfer gas long distances. The comparisons given between capital, labour, and general overhead requirements of the large manufacturing station compared with the small were most interesting.

In so far as coal gas was concerned, the North Thames Board accepted 7.5 mill. cu.ft. a day as the most suitable size. He agreed, for this provided, if sectionalised, 3 x 2.5 units, which gave a suitable proportion and sequence for repairs and resetting programme. It meant, however, that a complete works would have, say, 3.5 mill. C.W.G. making a total capacity of 11 mill. cu.ft. per diem, with an annual output of, say, 2,700 mill. cu.ft. per annum, and would serve a population of 250,000, or somewhat less if industrial demand was high. Unfortunately, there were wide tracts of the country where they could not realise such an aggregation. Of nearly 100 works in the Eastern Board, one only at present conformed to this optimum size; another had a mixed carbonisation system which rather defeated the capital costs argument, but their immediate plans would bring two more into this range of output, and the later plans three more.

On the section dealing with purification, in which there was much of general interest, he would like to have more information on the reasonable load purifiers for the smaller coal gas stream and C.W.G. stream up to 4 mill. cu.ft. a day. The 12 ft. deep box appeared to be a new departure from previous practice for the former Gas Light and Coke Company. Were they orthodox cast iron contruction—welded or rivetted steel—and was split flow employed?

He made the statement at the annual meeting last year that the difference in overall efficiency between one works and another was generally determined by the manner and efficiency with which steam and power were employed. And the financial results, if they assumed the same cost of raw materials, was in direct ratio to the efficiency in the use of steam and power.

At Ponders End, with intermittent verticals and producer gas dilution, maximum capacity 7.5 mill. a day and worked at a high load factor, the total direct cost of manufacture for the year ended March 31, 1951, was 6.62d. per therm, of which the cost of steam and power was 1.24%. Waste heat steam was used to generate as much power as possible, and exhaust steam was used for process work, and the balance of power required was purchased. One shell boiler only was kept under fire for standby purposes using breeze. Producer fuel was 13.27% of the coal carbonised. Total kWh 9.0 per ton.

At Southgate, a works with 3 mill. a day horizontals, and 3 mill. a day C.W.G., with a similar arrangement for steam and power, the direct cost of manufacture was 7.57d. per therm, and 2.57% went to steam and power. Producer fuel was 12.98% of coal carbonised. Electricity consumed 7.6 units per ton.

At Hemel Hempstead, a small works producing a maximum of 1.5 mill. cu.ft. a day, all in horizontal retorts, the steam and power cost was 2.3% of the direct cost of manufacture. The whole of the requirements were produced from the waste heat boiler, and the surplus steam was used on gas compressing plant. All electricity was purc' ased and amounted to 7.9 kWh per ton of coal.

He was glad that Dr. Burns had presented the interesting possibilities of waste heat recovery from continuous vertical retort systems by the application of the gas turbine and the generation of electricity. He hoped they would hear something from the West Midlands Board on this matter.

Elsewhere in his paper Dr. Burns had kept his feet firmly on the ground, but in speculating on the manner in which the surplus electricity might be employed, he showed that he had imagination. To use loose but popular parlance, 'what we couldn't do with cheap supplies of hydrogen or oxygen in the gas industry is just nobody's business. We have just got to get more therms per ton of coal to counterbalance the rising cost of coal, for our competitors are certainly increasing their unit production per ton.'

Mr. H. S. Cheetham (Humphreys and Glasgow, Ltd.) remarked that the part of the paper in which he was most interested was that relating to water gas manufacture, and, in particular, the reference to wet sealed and dry sealed—so-called—generators. Since his own Company were making both types of container, their only interest was to ensure that the type of plant installed was that which was best fitted to the local circumstances.

The First Dry Generator

The first dry generator built in America was built to designs prepared in this country. In regard to the question of dry generators, Dr. Burns expressed great preference for that type compared with the wet type, but his views were not shared by many engineers who had had experience of both types. It was possible to use much greater blast pressure in the case of wet generators where the limit was applied by the seal at the lower end of the generator, but, as Dr. Burns would agree, it was the rate at which air could be passed through the generator which was of importance in water gas manufacture. In the case of carburetted gas, that limit was reached when the amount of combustibles contained in the generator was sufficient to cause cracking of the oil. In the case of the blue water gas plant, the limit was reached when the coke was tending to be blown out of the generator. Both those conditions were obtainable in a wet sealed generator.

As far as the make per square foot of generator cross-sectional area was concerned, he could not quite agree with the figures which Dr. Burns had given. He thought that they might have been based on plant which was installed some years ago. The actual rate of make per square foot today was very little different in the case of either the wet or the dry type.

On general operation, Dr. Burns mentioned that the dry generator was more sensitive in its control. He agreed with him. That was certainly so, even when one had coke of good quality and, perhaps more important, of unified quality and of high fusing temperature. But whereas in this country the coke varied very widely in both its quality and other characteristics, there was no doubt in his mind that the wet sealed generator was very much easier to control. This had been shown on quite a number of occasions.

In the case of the operation generally of a dry generator, it was usually found that more steam was needed, and he thought that it was interesting to note here that, if one had to use, say, 5 lb. of steam per thousand in excess of the amount required on a generator, this in the case of a plant making 6 mill. cu.ft. a day might amount to £2,000 a year, which was a substantial sum in the operation of the plant.

It was interesting to recall that there was a very large industrial concern in this country which after many years' experience of dry generators later installed generators of the wet type; and they were large ones making up to about 10 mill. cu.ft. per day.

HORIZONTAL RETORTS*

By J. E. DAVIS,
M.Inst.Gas E., F.R.I.C.,
Chief Technical Officer,
and C. STOTT,
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C. STOTT.

IN 1921, the late Mr. G. M. Gill, then Chief Engineer to the former South Metropolitan Gas Company, presented to the Institution of Gas Engineers a paper on carbonisation in horizontal retorts,† and he then outlined certain desiderata that he described as 'special requirements of the present time.' Although 30 years have elapsed, these desiderata are still the same and they have not changed in the interval. They are:—

(1) To obtain the maximum duty from carbonising plant on account of its very high cost.
(2) To obtain the highest possible yield of gas and other products from the coal.
(3) To improve and to maintain good working conditions in the retort house.

The first requirement can be considered under two headings—namely, the daily throughput per unit of plant, which determines the total capital required to be invested, and the life of the plant, which, of course, represents the life of the capital investment.

Thirty Years Practice

Throughout the 30 years the coal carbonised has consisted of Durham and Northumberland run-of-mine, and the retorts employed have remained of oval section 21 in. × 15 in. × 20 ft. in length, except for a short period when oval retorts of a larger cross-section were tried. At the beginning of the period the weight of charge carbonised in 10 hr. was 10½ cwt. In the more recently built sections it is now 13¾ cwt. At the time of the earlier paper the average life of a retort was 1,500 working days and the weight of coal carbonised during the working life of a retort was 1,750 tons. Today it is considered reasonable to expect a working life of 4,000 days, during which period the retort will carbonise 6,000 tons of coal. In 1921 a gas yield of 70 therms per ton was considered a good performance, but, as charges became heavier and the general technique of operation improved, yields rose in the pre-war years to as high as 75 therms (of 560 B.Th.U. gas) per ton. The depreciation in coal quality as a consequence of the war has brought the figure to 72¼ therms, which represents a standard of performance equivalent to the 75 therms on coal of pre-war quality. By 1921, a daily make of 90 therms per retort had just been reached. In recently constructed settings the make approximates to 120 therms per retort.

In the main these improved results have not been obtained by radical departures in design, but by attention to detail, in both the construction and the operation of the plant. In this, the staff of the former South Metropolitan Gas Company had a number of advantages. With only one type of plant to be operated, the whole of their attention could be given to understanding that type of plant thoroughly, and as all constructional work was carried out by the Company the lessons learned in the operation of one unit could be applied to modifying the design in those units to be erected in the following year. Furthermore, the number of horizontal retorts was such that each year there fell due for reconstruction not a few settings within a bench, but one or more entire benches, a bench generally consisting of 15 to 16 settings.

The scale of working at each of the works was sufficient to justify the employment of retort house testers who, by making frequent analyses of waste gases and determinations of combustion chamber temperatures, permitted the settings to be worked continuously within a comparatively narrow margin of their maximum capacity.

In general design the horizontal retort setting of 1950 resembles closely that of 1921. The retorts are now constructed of silica segments, proper provision is made for expansion so that the inevitable changes of dimensions on heating-up do not distort the structure, producer capacity both in grate area and in coke capacity is more generous, and scrubber standpipes have taken the place of ascension pipes. Coke is quenched and removed from the retort house by the Fleuve system, and the disposition of producers is such as to make the removal of ash and clinker much easier. But this is not to say that there have been no attempts at more radical departures. Even in 1921, the retort houses at the Old Kent Road gasworks were provided with producers external to the retort house, the producer gas being conveyed hot through brick lined steel mains to recuperators beneath the settings. The object had been twofold—to remove the work of filling and clinkering producers from the retort house, so improving the working conditions there, and to prolong the life of the settings by settling the dust from the producer gas before it entered the settings.

Further Development

During the years 1925 to 1935, attempts were made to carry this line of development further by the introduction of steel cased external producers with hot filtration of the producer gas, and improved designs of recuperators. All these attempts must be considered to have failed. The work of producer operation, which was transferred from the retort house to an adjacent generator house, still had to be done and experience showed that the cost of doing it in the separate generator house was higher. Some success attended the efforts to remove the coarser dust from producer gas, but it was not this that did damage to the refractories. The fine dust continued to be fused in the producer gas flame and to cause slagging of the outer surface of the retorts, and indeed this effect was aggravated by the vapours of sodium salts derived from the water used to quench the coke supplied to the external producers, whereas the coke fed to internal producers was unquenched.

These experiences led to the conviction that if producer gas were to be cleaned, partial cleaning was useless and the job must be done thoroughly. This meant that the sensible heat of the producer gas had to be sacrificed entirely and much more efficient recuperation or regeneration would be

* Abstract of I.G.E. Communication No. 387
† Gill, G. M. Carbonisation in Horizontal Retorts. *Trans. Inst. Gas Eng.* 1920-21, 471.

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required. It had not proved possible to design recuperators that would be both efficient in transferring the heat of the waste gases to the incoming producer gas and secondary air and at the same time remain gas-tight for a reasonable period of years, and invariably settings provided with external producers showed fuel consumptions substantially higher than the settings served by built-in producers. An attempt was made to apply regenerators to horizontal retorts, these regenerators being fed with cold, washed producer gas. Technical success was achieved, but the capital cost of the regenerators and the necessary change-over gear was inordinately high, owing to the small coal capacity of the retorts served by each pair of regenerators.

In the course of this work and in related work that was carried out to improve the heating of the retorts on the flue side and so increase their throughput, heat balances were prepared showing the source of heat losses, and it was realised that however great a degree of success might be achieved in improving the throughput per retort and extending the life of the settings, horizontal retorts must always suffer from the limitations imposed by the high external heat-losing surface per unit of coal carbonising capacity and by the multiplicity of operations involved per unit weight of coal carbonised. The high ratio of heating surface imposed a limit to what could be achieved in the way of thermal efficiency and the multiplicity of operations to anything that could be done by way of reduction in carbonising wages or maintenance costs.

Coke Oven Tests

From 1928 to 1932, tests were carried out on coke ovens in England and on the Continent, covering the normal type of coke oven used for the production of metallurgical coke and ovens of smaller size, which had been adapted in Germany for gasworks use. By comparison with the information obtained in horizontal retorts, it was clear that the full-size coke oven provided an arrangement in which the heat-losing surface per unit volume of coal carbonising capacity was much reduced, and to which efficient regenerators could be applied without undue capital cost. As the weight of the charge in ovens is about 20 times that in horizontal retorts, the number of operations required per unit weight of coal carbonised was reduced in approximately this ratio, leading to possible savings in both operating and maintenance wages. Indeed, at that time it was considered that under the conditions existing at the East Greenwich gasworks, coke ovens should show a saving of about ¼d. a therm, as compared with horizontal retorts, but to obtain these advantages it was necessary to install plant with a capacity of not less than 1,000 tons of coal a day. There was then no opportunity to do this. From 1921 to 1931, the output of gas by the former South Metropolitan Gas Company had grown steadily, but the improving technique in the operation of horizontal retorts had given a 20% increase in the output per unit of plant, and, although settings that had been worked out were renewed year by year, there was no case for building additional plant. Had sales of gas continued to increase, however, the time would have arrived when new plant would have been necessary, and coke ovens could have been installed; but, from 1931 onwards, a recession in business took place, due largely to the loss of the lighting load and to movement of the population from the area of supply of the Company to that of adjacent companies, and the opportunity to install coke ovens did not occur until increasing demands for gas, combined with arrears of renewals during the war period, made it essential to erect new plant from 1945 onwards.

Meanwhile, another difficulty had occurred. Today, an installation consisting solely of horizontal retorts would be regarded as embarrassingly inflexible, but this had not always been the case. In the early 1920s, it was possible to adopt a method of working that catered for the variation in gas demand from summer to winter and from week to week. Retorts lasted only 1,500 days, and indeed to make them last this long repairs to the retorts themselves, to the combustion arches (which not infrequently would collapse after two winters' work), and to producer linings, meant that the summer recession in demand was a welcome opportunity to carry out necessary retort house repairs. It was possible to employ labour in the retort houses during the winter months and to transfer it to setting repair work in the summer time, added to which there was alternative employment locally during the summer months for the less skilled labour, and work in the gasworks during the winter months was a welcome alternative to unemployment during the winter, when outdoor work was less readily available. These circumstances permitted seasonal variation to be accommodated comfortably.

Variations in demand from week to week were met by varying the amount of Sunday work. It was customary to discontinue gas-making from 6 a.m. Sunday to 10 p.m. Sunday, with a view to giving the men a break and to avoid employment at double-time rates. Normally, the holders would be full by 6 a.m. Sunday and gas was taken from stock during the period of shut-down. If, however, by Saturday evening it was clear that the demands during the week would prevent the holders from being full on Sunday morning, either one or two shifts could be worked on the Sunday, this giving a 10% variation on the week's gas production. An unusually warm spell would not be accommodated by this device, but would need 12 hr. or even 20 hr. carbonising periods during the week.

During the years when the weight of charge did not exceed 11 cwt. or 11¼ cwt., it was possible at times of exceptionally high demand to carbonise this charge in 9 hr., giving a further 10% gain over and above the rated capacity of the plant.

But circumstances were changing and, as success attended the efforts to prolong the life of retorts and settings, a smaller proportion needed repair each summer, and the position arose when settings were being let down in the summer-time only because they were not needed for gas-making, and the cooling down of the structure made necessary the repairs that would not have been needed had the plant continued at work. The increase in weight of charge was made possible only by working the settings more nearly to the safety limit, and this greatly reduced the possibility of emergency 9 hr. work.

Continuity of Employment

It was foreseen before the war, and realised after the war, that all men employed must be given an assurance of continued employment and that the distribution of process work over the seven days of the week must be uniform. With these changes in circumstances, plant which had once been able to provide the desired degree of variability became highly inflexible, and it was realised that carbonising plant, whether horizontal retorts or the coke ovens that it was hoped to install, could be regarded in the main only as base load plant, and that variations in demand must be met by plant of another type.

The East Greenwich gasworks is well situated for the receipt of coal direct by ship from the North, and for disposal of coke by rail, road, and water, and in these circumstances the coal gas therm is cheaper than the carburetted water gas therm at 500 B.Th.U. so long as the annual load factor on the carbonising plant is not less than 50%. Therefore, although the installation of water gas plant was indicated in order that carbonising plant might be operated at level load from day to day and at the best load factor over the year, it was equally necessary that as high a proportion as possible of the total therms produced per annum should be coal gas therms. A degree of flexibility in output adequate to meet fluctuating demands from day to day and from week to week throughout the year can be provided by alternative dilution of the rich coal gas made in coke ovens and horizontal retorts down to a declared calorific value of 500 B.Th.U., the alternative diluents being producer gas and blue water gas. When producer gas is used as the diluent its low calorific value of 125 B.Th.U. permits the addition of

only about 13% by volume, but with blue water gas of 290 B.Th.U. the proportion of diluent gas is increased to about 23%. Thus, a 10% increase in the output of a works can be obtained by the simple expedient of altering the composition of the diluent gas.

There remains, however, the problem of meeting short-lived peak demands in the winter months, and for this purpose, pending the development of more appropriate processes, carburetted water gas has the advantage of low capital costs in relation to daily output. Thus, in planning the new installation for the East Greenwich works, coke ovens were visualised as carbonising plant for the full base load of 365 days per annum, with some horizontal retorts remaining for operation during the spring and autumn months, the total installed capacity of carbonising plant being approximately equivalent to the mean day's output. If the mean day's output be taken as 100, provision has to be made for meeting a maximum demand equivalent to 160, and, of the additional 60 volumes required, 30 can be provided by blue water gas used as a diluent for the coal gas and the balance of 30 volumes by carburetted water gas of 500 B.Th.U. In such circumstances, the programme of operation can be arranged to provide between 80 and 85% of the total therms made in the year in the form of coal gas, and it was on these principles that the re-development of the East Greenwich works was planned.

It is not the purpose of this Paper to describe the plant installed at the East Greenwich Works, for that description has been made available elsewhere.* The purpose has been to trace the line of thought as it unfolded over a period of years, and led to the reconstruction of the largest gas manufacturing station of the South Eastern Gas Board. In preparing the paper the authors have been conscious that they have been compiling a record not of their own work, but of a team of workers led first by the late Dr. Charles Carpenter, and latterly by Dr. E. V. Evans, O.B.E. They have felt it a privilege to be able to place these developments on record and are grateful to the South Eastern Gas Board for permission and encouragement to do so.

Producers

(A) Built-in Producers.

Built-in producers were incorporated in the original design of retort settings and have been modified and improved in the passage of time. They still form an integral part of the modern standard retort setting.

The characteristics of this type of producer are well known. Its disadvantages in practice are the intermittent variations in gas supply due to periodical clinkering, the delay in the conduct of the 'draw' and the additional labour involved in charging the producer. The manual work entailed in dealing with the massive clinker produced by the shortcomings of grate water as an endothermic agent is heavy, and the carry over of dust causes surface fusion, with erosion of the refractory material in the setting, and additional labour in clearing flues and ports of deposited dust. Difficulty in close control is sometimes cited as a further disadvantage, but with producers of good design, properly operated and maintained, no difficulty should be experienced in maintaining combustion chamber temperatures within $\pm 15°C$. of the desired figure.

Its advantages lie in its simplicity and low first cost, the elementary nature of the repair work, and the over-riding factor of its fuel economy by reason of the utilisation of the sensible heat of the hot coke charge and the hot gas.

The important features of design to which attention has been directed are:—

(*a*) The specification of suitable refractories as producer lining in respect of the clinker zone, the upper zone, and the arch.

(*b*) The provision of adequate grate area.

(*c*) The dimensions of the grate well, permitting the ready removal of all clinker formed.

(*d*) A depth of fuel from the grate to the gas offtake sufficient to ensure an adequate time of contact between the fuel and gas. This length of travel should be preserved at all times and can be ensured by providing a curtain arch and adequate coke storage within the producer.

(*e*) The positive and uniform distribution of clean water to the grate in controlled quantity.

(*f*) Tight-fitting doors to the producer grate, and provision for positive control of the primary air admission.

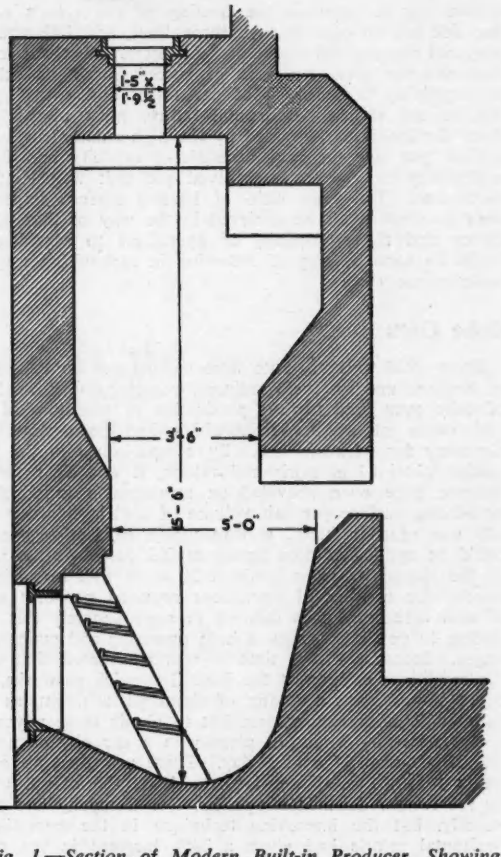

Fig. 1.—Section of Modern Built-in Producer, Showing Ample Coke Storage Space and Curtain Wall.

(*g*) Feed holes of full cross-section, and positioned to admit the smooth feed of coke as discharged from the retort. Feed covers of reasonable weight provided with a simple and effective seal.

Numerical data relating to built-in producers are given in Table 1.

Table 1.—*Numerical Data Relating to Built-in Producers.*

Built-in Step Grate Producers—Standard Retort Benches

	Prior to 1928	1928–1945	Present
Settings per producer	1¼	1¼	1
Dry coke gasified per day (tons)	3·72	3·96	2·84
Grate area (sq. ft.)	31·2	30·2	22·0
Coke gasified per sq. ft. per hr. (lb.) ...	11·1	12·3	12·1
Minimum depth of fuel bed	4 ft. 6 in.	5 ft. 1 in.	5 ft. 1 in.
Coke capacity:			
Grate well (tons)	1·43	1·34	0·98
Storage (tons)	0·72	2·86	2·97
Total (tons)	2·15	4·20	3·95

* *Gas Journal*, 254, December 13, 1950 ; 553.

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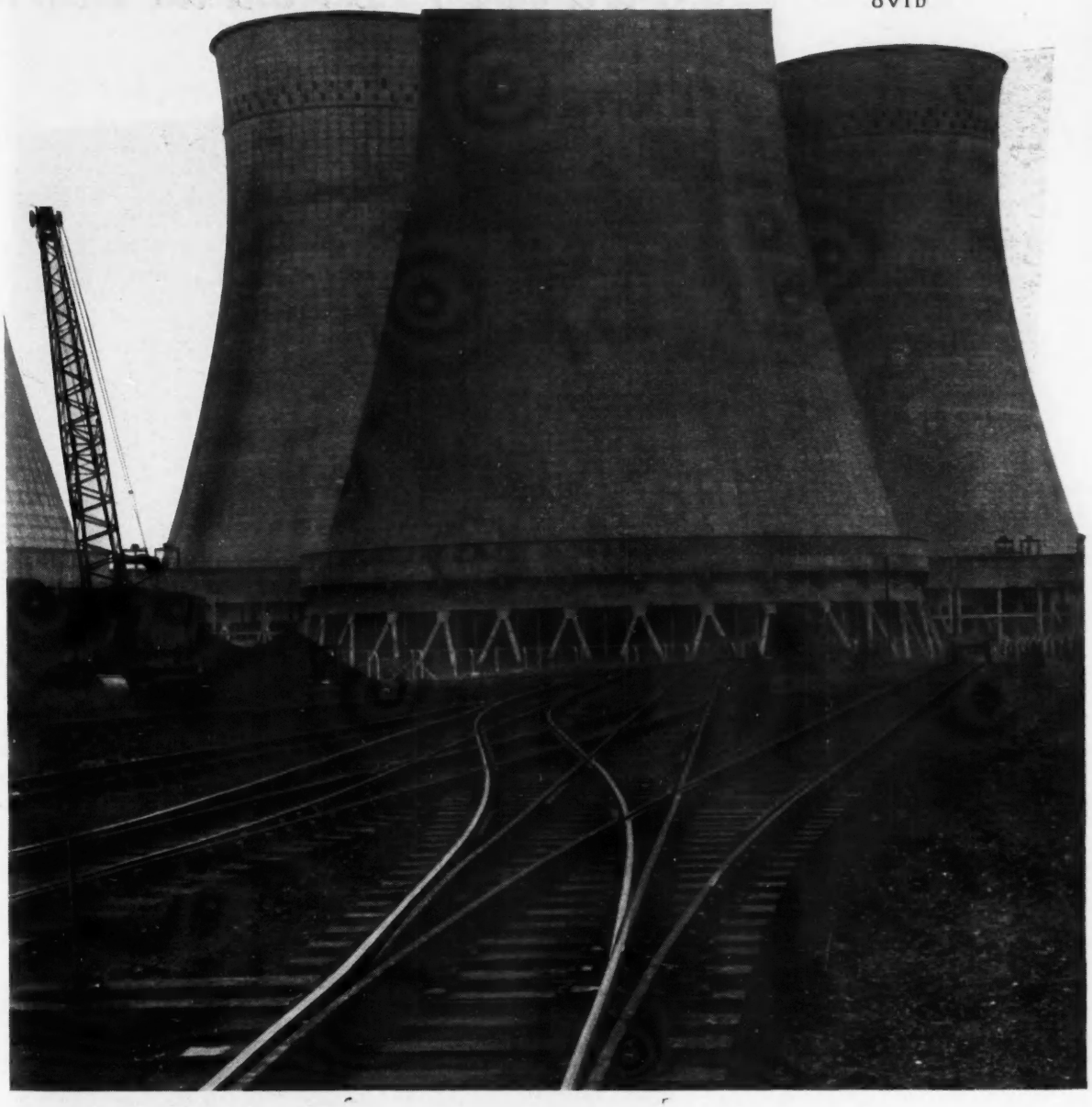

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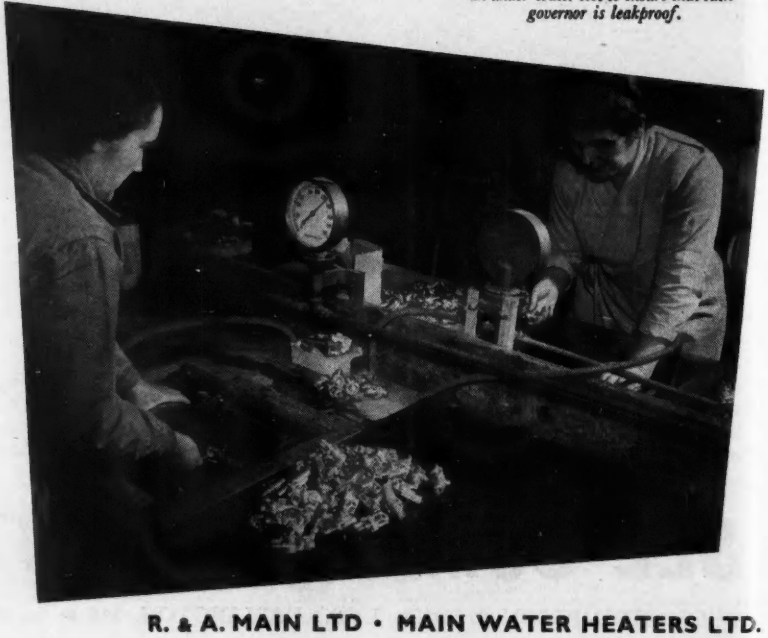

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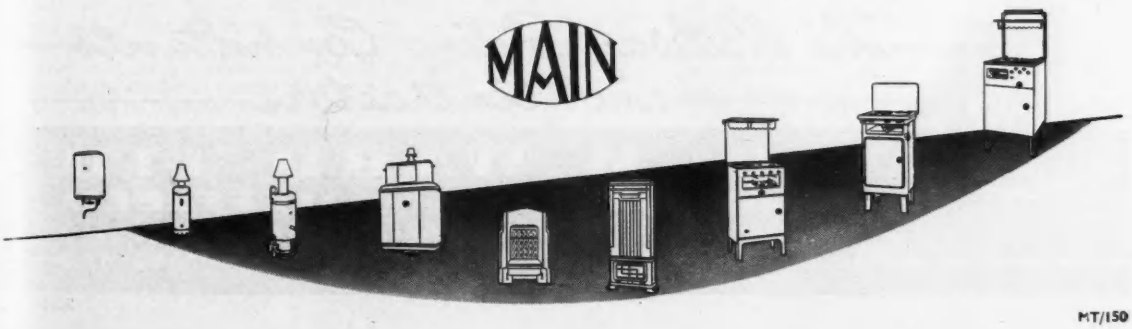

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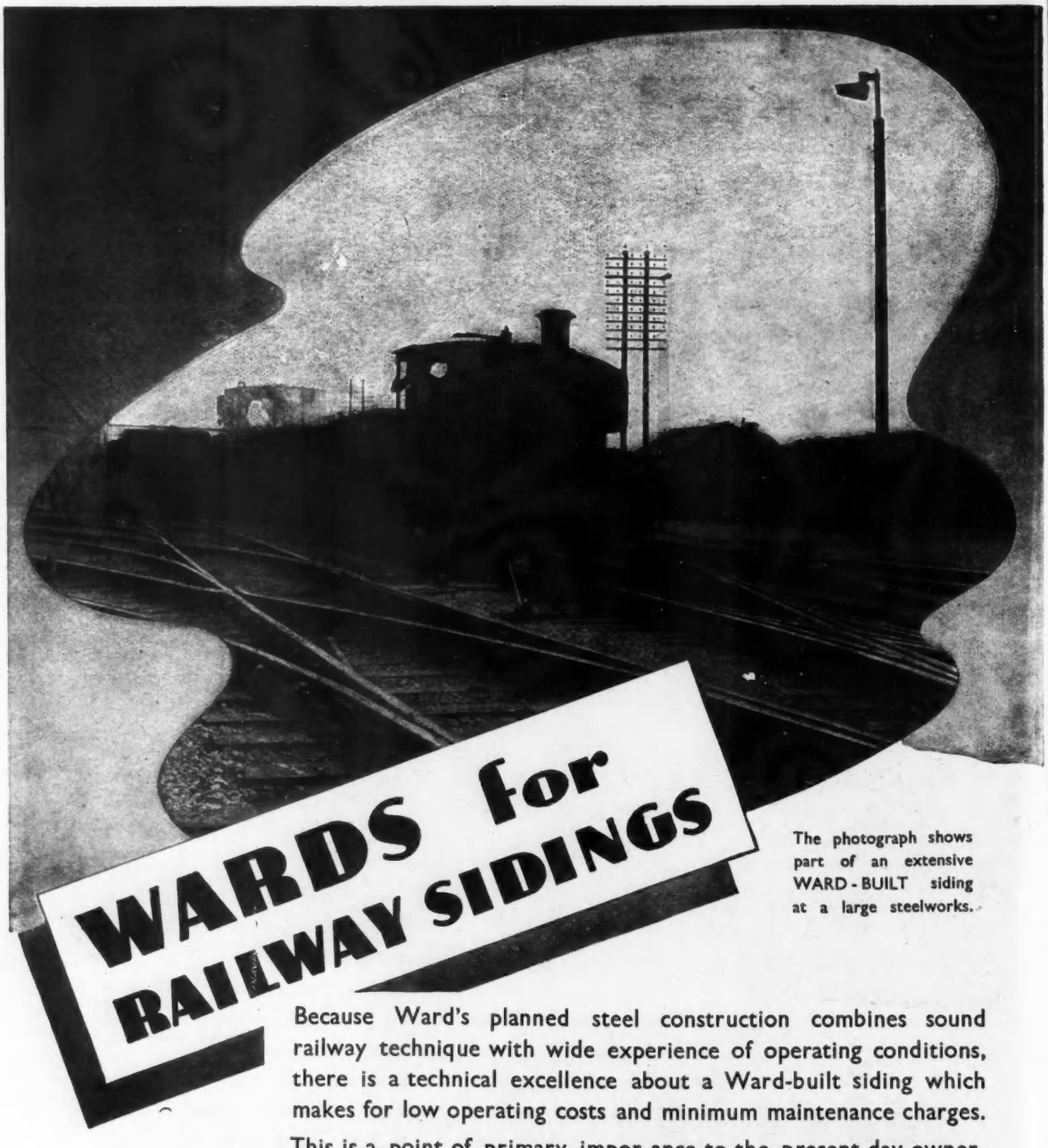

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The modern setting is provided each with its own independent producer (Fig. 1) with rail access to facilitate the direct loading of ash from pan to truck, an arrangement that has improved considerably the amenities below stage level.

After entering a dust chamber 20 ft. in length, forming part of the structure below stage level, the gas enters the CO tunnel at 970°C. The average gas analysis is:—

	%
CO_2	4.6
CO	28.1
CH_4	0.2
H_2	7.0
N_2	60.1

Calorific value (gross) ... 113.4 B.Th.U. per cu.ft.

The air for combustion is preheated by heat conducted downwards through the brickwork and enters the last duct at the nostril block at 300°C.

The fuel consumption under these conditions averages 17.1 lb. of dry coke per 100 lb. of coal carbonised. All retort benches built to the modern standard are provided with waste-heat boilers raising steam at 160 lb. per sq. in., superheated to 500°F., as an integral part of the works power system. The steam raised, less the consumption on the boiler auxiliaries, is 2.77 lb. per lb. of dry coke to producers. Crediting the producers with the coke equivalent of the steam raised, the net usage on producers is 13.4 lb. per 100 lb. coal carbonised.

(B) External Producers.

More than 40 years ago at Old Kent Road works, external producers of the step-grate pattern were installed on all retort houses. The individual producers had a throughput of 23 tons of run-of-retort coke per day; they were brick-built and the design (Fig. 2) of grate was similar to that of the built-in producer, each producer having four grates. They were blown with low pressure air, and the normal grate water addition was supplemented by exhaust steam. The gas from each producer was passed through a series of three dust boxes, and its admission to individual settings was controlled by valves on the feeder mains. The gas was of excellent quality, with combustion characteristics well suited to its efficient use in the standard design of setting.

A summary of the producer performance is given in Table 2.

TABLE 2.—*Operating Data.*

EXTERNAL PRODUCER—BRICK BUILT

	%
Gas analysis:—CO_2	3·0
CO	31·2
CH_4	0·8
H_2	9·0
N_2	56·0
Calorific value (gross)...	135·9 B.Th.U.
Calorific value (net)	131·4 B.Th.U.
Fuel :	Run-of-retort coke.
Moisture	5%
Ash	12%
Combustible matter in clinker ...	35%
Cold gas efficiency	81·4%
Grate area	81·5 sq. ft.
Dry coke gasified per hr. per sq. ft. grate area...	25·0 lb.

The gasification rate in this producer per sq. ft. of grate area was twice that in built-in producers, yet the typical analysis of the gas gave no indication of overload. The descent of the coke from the feed hole to the grate took place in such a manner as to keep the coke and breeze admixture uniform throughout. Even so, the grate area allowed must have been at or near the limit, for after 1940, with the deterioration of coal and coke quality, the grate area had to be increased by 50%, reducing the rate of gasification to 16.6 lb. per sq. ft. per hr.

In 1925 the external producer was redesigned, the features of the new design (Fig. 3) being:—

(*a*) The provision of a steel-cased producer unit.

(*b*) The retention of the step-gate principle. The section at the level of the upper step was a square, step grates forming the sides of the square and giving, in effect, a basket grate. The base of the basket was provided with a grid. The grate area was 67.5 sq. ft., and the throat area 53.7 sq. ft.

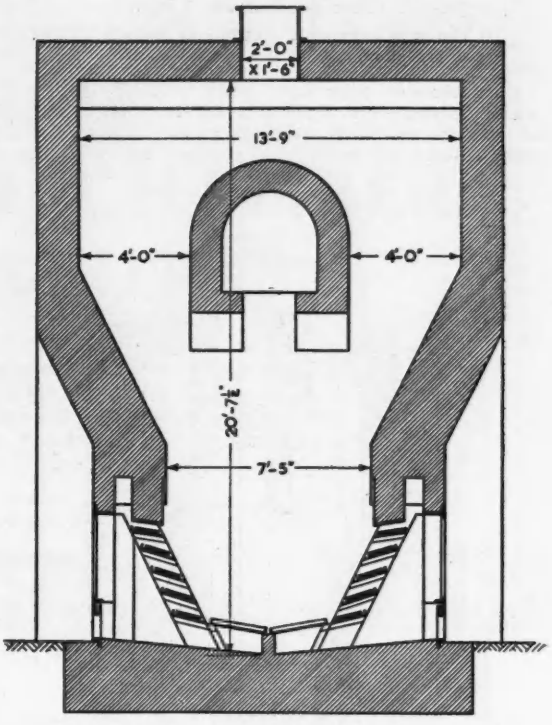

Fig. 2.—Section of External Step-grate Producer.

(*c*) Below the grate there was storage for the clinker removed at the end of each 16 hr. period. A secondary air blast was supplied to the storage pit with the object of completing the combustion of carbon removed with the clinker and returning the products of combustion as an endothermic reagent to the base of the grate. By this means there was a possible economy of the order of 7% of the fuel fed to producers. The ash was finally discharged to rail wagon through a luted door at the base of the pit.

(*d*) The producer proper was covered by a dome of refractory blocks with the gas outlet at the apex. Above the dome the structure continued upwards to form an internal storage for producer fuel of 8 tons capacity. Four openings in the dome allowed the fuel to replenish the fuel bed at the grate.

(*e*) The advantages of clean producer gas were obvious, and the possibility of dust removal without incurring undue loss of sensible heat was explored. Hot gas filters were designed and installed at the producer outlet. The gas entered at the top of a central receiving channel by a rectangular flue of 3.37 sq. ft. cross-section, and then passed laterally through primary and secondary columns of a filtering medium formed by a vertical, continuous curtain of granulated, calcined flint flowing between opposed louvre tiles. Eight primary columns were provided, and the gas admission ports to the filter columns, consisted of 384 rectangular slots, each 11 in. × 3¼ in., giving a total superficial area of admission of 102.5 sq. ft. The secondary columns were a duplication

of this arrangement. The flint was withdrawn continuously at the base of the columns by variable speed rotary extractors, then screened to remove the dust, and the over-size returned to the circuit. The rate of extraction was such as to replace the flint in the primary columns and secondary columns once in 12 hr. and 24 hr. respectively. The differential pressure across the filter was 1 in. W.G.

(*f*) The producers were grouped to form a central producer plant.

Comprehensive trials were made, covering in turn the addition of waste gas to the blast, the use of water atomisers at the grate and steam saturation of the blast, over a wide range of coke fuel quality and grading. This work was on

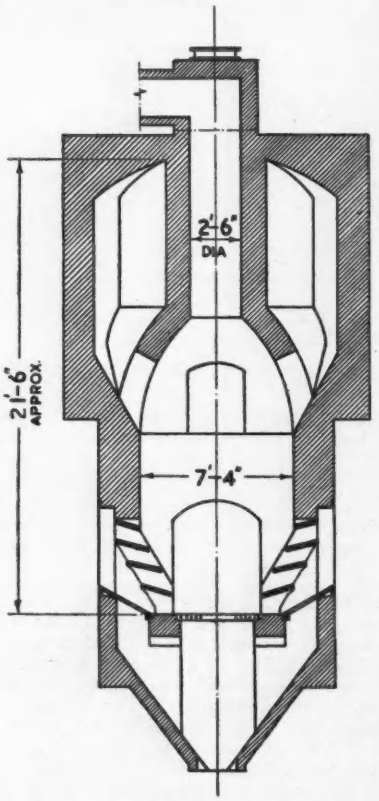

Fig. 3.—Section of External Steel-cased Producer.

the full practical scale and covered the heating of horizontal retort settings, carbonising 230 tons of coal per day. The performance of the carbonising plant reacted sharply to the varying quality of producer gas made on different trials, and it became evident that parity in thermal input of producer gas was not of itself sufficient, but that the heat supplied should be at a potential suited to the furnace design. It is not claimed that the settings were originally designed to deal with a gas of any particular quality, but the cumulative effect of minor changes over a period of years led to an empirical, but none the less close, association between design and gas quality. This aspect is well illustrated by two extracts from the records:—

(1) This type of producer gave best performance on run-of-retort coke at a rating of 12 tons per day as fed, equivalent to a gasification rate of 15.8 lb. of dry coke per hr. per sq. ft. grate area, and with a steam decomposition of 0.34 lb. per lb. of fuel. (See Table 3.)

TABLE 3.—*Operating Data.*

EXTERNAL PRODUCER—STEEL-CASED

		%
Gas analysis:—CO_2	... ...	3·2
CO	... ...	31·2
CH_4	... ...	0·8
H_2	... ...	10·8
N_2	... ...	54·0
Calorific value (gross)	... ...	141·6 B.Th.U.
Combustible matter in ash	... ...	15·6%
(1) Cold gas efficiency	... ...	85·3%
(2) = (1) Less stack losses	... ...	83·1%
Dry coke to producers per 100 lb. coal carbonised	... ...	18·9%

(2) On 80% run-of-retort coke and 20% breeze, the cold gas efficiency fell to 77.4%, and the fuel requirement rose to 22.2 lb. of dry coke per 100 lb. of coal carbonised. The gas supplied to the settings had the composition:—

	%
CO_2	5.0
CO	28.1
CH_4	0.7
H_2	9.9
N_2	56.3

Calorific value (gross) ... 128 B.Th.U.

Correcting for the fall in the efficiency of the producer itself, the fuel consumption was equivalent to 20.3 lb. per 100 lb. of coal carbonised, representing a 10% increase due to the lower theoretical flame temperature of the producer gas.

(i) *Filtration of Hot Producer Gas.*

The performance of the flint curtain filter fell short of expectations for three reasons:—

(*a*) The granular curtain filter was inherently incapable of dealing with the finer dust.

(*b*) The duty on the producers was, in general, in excess of their real capacity, particularly when working producers were run on overload to cover a producer cut out for charging or clinkering. The amount of dust carried in the gas rose sharply with the load.

(*c*) The gas temperature in the filters fell below 800°C., and common salt vaporised from the coke in the producer was deposited, forming with the dust a brown parchment-like incrustration on the internal brickwork. This caused a progressive restriction of the area of the admission ports to the filter columns and raised the gas velocity through the unimpaired sections of the columns.

Table 4 gives a typical series of results and illustrates the relationship of load to the weight of dust removed.

TABLE 4.—*Dust Removed from Producer Gas made in Steel-cased Producers.*

Fuel Gasified : Coke Scalpings	Fuel Gasified per Producer per Day	Dust Extracted per Filter per Day
Grading:—	Tons	Lb.
Less than 2 in. ...	9·4	8·7
Less than 2 in. ...	10·5	12·9
Less than 1¾ in. ...	12·2	16·0
Less than 2 in. ...	12·6	21·4
Less than 1¾ in. ...	12·8	23·3

Although the higher figures represented an extraction of 1,900 lb. of dust per setting per year, this was by no means the total weight of dust in the producer gas. The finer dust, which was not removed by the filters, was still sufficient to cause slagging of the refractories in the settings.

(*ii*) *The Use of Inferior Grades of Coke as Producer Fuel.*

The central external producer plants were costly, but the added cost could be justified if there had been a reduced fuel consumption resulting from efficient recuperation or

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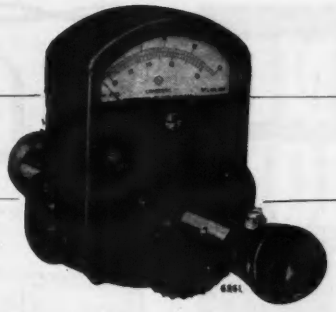

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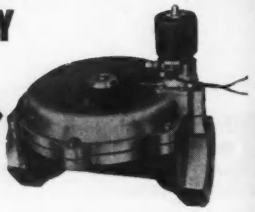

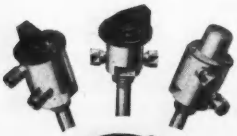

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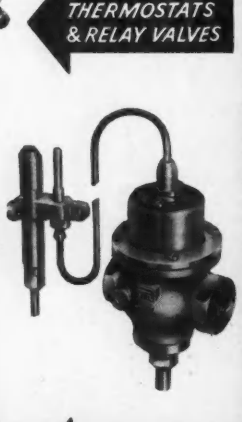

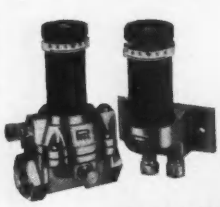

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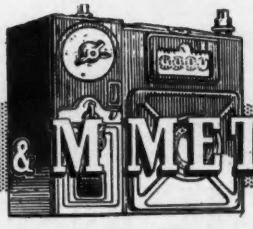

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regeneration on the carbonising plant, or an ability to use low grade fuel in the producers.

The fuel consumption was inevitably higher with external producers than with built-in producers and jacketed settings, but there remained the possibility of justifying the more expensive plant by the use of cheap fuel, of which there were two possible sources of supply.

The net revenue from breeze at that time was almost negligible and if a producer fuel composed of 60% run-of-retort coke and 40% breeze could be gasified satisfactorily, the average cost of this fuel would be low.

An effort was being made to develop the domestic market for coke and it was clear that the high moisture and ash content of the smaller sizes screened from run-of-retort coke were a severe handicap to this business. Grizzly screens were installed on the coke conveyor system, the screen openings being adjusted to pass the weight of producer fuel required, leaving the over-size coke lower in moisture and ash to pass forward to the coke preparation plants.

(iii) *Coke-Breeze Mixtures as Producer Fuel.*

The importance of a uniform mixture was realised and the following methods of mixing were tried:—

(*a*) Fuel loaded to bunker in units of 12 cwt.

(*b*) Stratified loading.

(*c*) Fuel mixed at loading point in 1 cwt. increments.

The last method gave the best results, the clinkering time per producer per day being 110 min. against 133 min. by other methods of mixing.

The results obtained are summarised in Table 5.

TABLE 5.—*Operating Results from Steel-cased Producers Working on Coke/Breeze Mixtures.*

	Average Daily Figures for Producers		
	A	B	C
Hours at Work	21·1	20·8	21·2
Hours occupied in clinkering	2·1	2·2	1·8
Hours occupied in charging, ash removal, etc.	0·8	1·0	1·0
Fuel throughput as weighed (tons) ...	16·4	15·7	13·0
Moisture, 12·2%			
Ash, 16·7%			
Less than ¼ in., 52·5%			
	%	%	%
Gas analysis:—CO_2	3·9	3·8	3·1
CO	29·0	29·2	30·2
CH_4	0·7	0·7	0·7
H_2	6·2	5·9	7·4
N_2	60·2	60·4	58·6
Calorific value:—	B.Th.U. per cu. ft.		
Gross	119·1	118·7	126·7
Net	115·1	114·9	122·1

These trials were conducted at a period when grate water was being supplemented by the addition of waste gas to the blast.

The pronounced advantage in efficiency found on C producer can be ascribed to the fact that this producer was working at approximately the normal rating (12 tons per day), while A and B carried a continuous overload of 37 and 31% respectively. Experience showed that while such overloads could be carried when the fuel was run-of-retort coke, they led to a deterioration in efficiency and gas quality when high percentages of breeze were employed, due to segregation of breeze, which reduced the effective area of the fuel bed.

This fall in efficiency and the depreciation in the calorific value of the gas, still further reduced by the dilution effect of water vapour carried forward from the coke, was strongly reflected in carbonising conditions and fuel consumption, and the use in practice of this blended fuel could not be justified.

(iv) *Small Coke as Producer Fuel.*

Trials were then made on the steel-cased external step-grate producers using various grades of small coke, and the conclusion was reached that, for reasonable operation, fuel used should contain not less than 25% greater than 1¼ in., and not more than 38% less than ¼ in. Scalpings were then employed as producer fuel, the run-of-retort coke being passed over a grizzly screen so adjusted that the under-size passing the screen was just sufficient to meet producer requirements.

Variations in the type of coal being carbonised caused changes in the size distribution in the coke, and frequent adjustment of the screens was necessary, the matter being further complicated by the time lag introduced by the capacity of the fuel storage hoppers. Some idea of the extent of these variations can be gained from Table 6.

TABLE 6.—*Variation in Quantity and Quality of Scalpings.*

Grizzly Screen Opening	Weight of Screenings as a percentage of total Coke made	
	Maximum	Minimum
2 7/8 in.	36·1	29·6
2 in.	35·9	28·9
1¾ in.	34·6	26·6
1½ in.	32·3	24·5

Daily Breeze Content (less than ½ in.):—36·1% Maximum, 10·4% Minimum, 18·6% Average

Grading Tests:—	Maximum	Minimum	Average
Greater than 2 in. ...	6·0	1·2	3·3
2 to 1½ in.	53·6	42·1	50·4
1½ to ¾ in.	33·5	25·3	27·8
¾ to ½ in.	8·2	6·4	7·4
Less than ½ in. ...	13·5	9·0	11·1

This fuel was gasified without difficulty on the works scale with the results given in Table 7.

TABLE 7.—*Operating Results of Steel-cased Producer, using Scalpings.*

Fuel:—Moisture, 19·1%; Ash, 13·1%

Daily throughput per producer:—	
As fed	14·2 tons
Dry coke	11·5 tons
Combustible matter in ash	27·4%
Fuel loss by stack	3·6%
Blast saturation temperature	54·7°C.
Percentage steam decomposed ...	85·5%

Gas analysis:—	Dry	Wet
	%	%
CO_2	4·5	4·2
CO	29·1	27·3
CH_4	0·8	0·8
H_2	10·6	9·9
N_2	55·0	51·6
H_2O	—	6·2

Cold gas efficiency	81·7%
Calorific value (gross)...	134·3 B.Th.U.
Fuel to producers (dry) per 100 lb. coal carbonised	17·9 lb.*

* Carbonisation conducted in recuperative settings in 20 ft. retorts of 25 in. × 15 in. oval section on 12 hr. carbonising period.

(v) *Further Problems in the Operation of External Producers of the Step-grate Design.*

This type of producer had to be isolated from the mains at intervals for charging and clinkering, and at these times the stack valve was open to atmosphere. Under these conditions of natural draught through the producer the gas lost at the stack amounted to 34,000 cu.ft. per hr., and during the clinkering period the composition of this gas was:—

	%
CO_2	1.7
O_2	0.2
CO	39.2
H_2	30.2
N_2	28.7

Calorific value (gross) ... 221 B.Th.U.

This unusual composition resulted from the mixture of high quality producer gas made under natural draught conditions and water gas from the high vaporisation of grate water during clinkering. Obviously, such a gas could be made only by calling upon the sensible heat stored in the fuel bed, and the cooling of the bed by endothermic reactions had an adverse effect on the performance of the producer when it was put back on the main.

Because of the high calorific value of the gas lost, the stack loss was much higher than the volume indicated, and amounted to about ½ ton of coke per hr.

During this periodic isolation of producer units, the volume of fuel gas to settings could be maintained only by subjecting the rest of the producers to overload, resulting in some reduction of the calorific value of the producer gas supplied. The deterioration in the gas quality was accentuated by the high steam content of the gas resulting from the gasification of a fuel containing up to 20% moisture. Low-flame temperatures and high fuel consumption were the result.

A procedure was devised to avoid the adverse effect of these three factors:—

(1) The stack loss.

(2) The overloading of working producers during the clinkering period on the laid-off producer.

(3) The high moisture content of the fuel.

The producer was charged immediately before clinkering, and gas was drawn through the freshly charged coke by a fan that discharged the gas through a water scrubber and thence into the producer gas main.

Preliminary results obtained over a 30 min. clinkering period were:—

Suction Gas Analysis.

	%
CO_2	2.2
O_2	0.4
CO	32.9
H_2	9.6
N_2	54.9

Calorific value (gross) ... 136 B.Th.U.
Volume of gas drawn off ... 40,840 cu.ft. (dry).

Moisture removed from coke charge:—

	Lb.
2.5 p.m. to 2.15 p.m.	31
2.15 p.m. to 2.25 p.m.	142
2.25 p.m. to 2.35 p.m.	1,286

It was finally established that by increasing the suction effect, the producer could be kept under normal load during clinkering, giving a gas of the following composition:—

	%
CO_2	4.0
O_2	0.6
CO	28.0
H_2	12.4
N_2	55.0

Calorific value (gross) ... 128.6 B.Th.U.

While the method was technically successful, the degree of supervision and control required precluded its adoption in regular works practice.

There was adopted, however, a modification of the principle, whereby a constant proportion of the producer gas made was taken upward through the fuel storage zone, through auxiliary offtakes at the producer top, thence through water spray scrubbers, and finally passed to the hot producer gas mains. This flow was effected by the producer pressure and was continuous so long as the producer was under blast, forming, in effect, a by-pass to the flint filters of a proportion of the total make. In the original trials it was found that 17½% of the total make of producer gas had to be by-passed in order to dry fuel containing 15% moisture. With scalpings containing 20% moisture, the required volume of by-pass was 25% of the make. Design consideration prevented this figure being reached, but the following water balance for a week's run in a central plant of five producers indicates the degree of success achieved:—

	Tons
Steam to blast	133.4
Steam decomposed	112.8
Steam undecomposed	20.6
Moisture in coke fed	93.7
Total moisture	114.3
Moisture in gas to settings	71.9
Moisture removed in by-pass cooler	42.4

Removal of water by by-pass equivalent to 45% of moisture in coke fed.

(c) MECHANICAL PRODUCERS.

(i) *Initial Experimental Work.*

By 1930 the extensive and varied work carried out on the performance of the external step-grate producer had led to very definite conclusions regarding the limitations of this type, and it was clear that future installations would have to be based on other methods of producer gas generation.

Trials were made using a producer well known in steel works practice. Its rating was 50 tons per day on coal, and the internal diameter was 10 ft. The producer was entirely mechanical and fitted with automatic feed, the producer shell being rotated above a fixed blast hood and ash bowl. Ash removal was effected by dropping the plough to the depth required, and the fuel bed was kept stirred by the use of a mechanical poker. The working depth of fuel was 4 ft. after allowing for 1 ft. of ash covering the blast hood.

One retort house was supplied entirely by gas from this producer, and the trials were conducted at a time of the year when the number of settings in use could be varied according to the heating capacity of the gas available. The fuel used in these tests was small coke of various gradings containing, in some cases, a proportion of breeze. The results obtained are seen in Table 8.

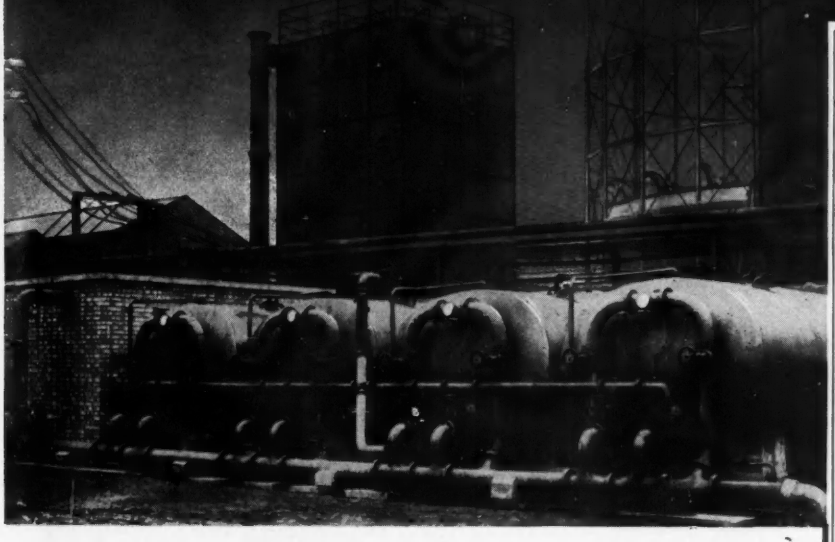
TABLE 8.—*Operating Results from Mechanical Producer.*

FUEL:—		
Grade used	2½ in.	2½ to ¾ in.
Grading Test:—		
Greater than 3 in.	Nil	Nil
3 to 2 in.	0·5%	0·6%
2 to 1½ in.	36·4%	45·2%
1½ to ¾ in.	36·7%	45·8%
¾ to ½ in.	12·2%	5·3%
Less than ½ in.	14·2%	3·1%
Moisture	10·2%	11·4%
Ash	12·3%	12·3%
Tons per day:—As fed	19·6	19·1
As dry coke	17·6	16·9
COMBUSTIBLE MATTER IN CLINKER	27·4%	18·4%
Fuel loss by combustible matter	5·3%	3·2%
GAS ANALYSIS:—CO_2	8·0%	7·0%
CO	24·0%	25·6%
CH_4	0·7%	0·6%
H_2	10·8%	11·7%
N_2	56·5%	55·1%
Calorific value (gross) (B.Th.U. per cu. ft.)	117·8	124·8
Moisture in gas made	9·9%	8·5%
STEAM BALANCE PER TON FUEL:—		
Steam added to blast	1,382 lb.	1,233 lb.
Steam decomposed	768 lb.	864 lb.
Steam forward	614 lb.	369 lb.
Moisture in coke	232 lb.	255 lb.
Total steam forward	846 lb.	624 lb.
Average saturation temperature of blast	61·4°C.	61·4°C.
Steam decomposed	55·6%	70·0%
COLD GAS EFFICIENCY	73·7%	78·3%
WORK DONE IN SETTINGS, PER DAY:—		
Period of carbonisation	19·1 hr.	17·7 hr.
Coal carbonised	47·3 tons	49·4 tons
Dry coke used	17·6 tons	16·9 tons
Dry coke per 100 lb. coal carbonised	37·2 lb.	34·2 lb.
Average temperature of settings	1,209°C.	1,279°C.

The producer as designed would not gasify more than 20 tons per day of coke below 2½ in. The blast hood delivered an excessive proportion of blast to the periphery of the fuel bed, and much hand poking was required to deal with the clinker formed in this zone. To reduce clinker formation, the blast saturation temperature had to be maintained at 61° to 62°C., and this heavy steaming, combined with partial combustion of gas in air channelling through the bed, accounted for the low quality of gas made. The average moisture content of the gas was very high at 9% and the percentage of combustible gas in the wet gas supplied to the settings was only 38%. The settings fed by the gas from this producer were of the semi-recuperative type in which the fuel gas and air were preheated to only a moderate

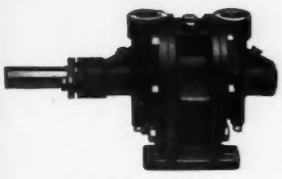
Pulsometer

PUMPS AND FILTERS

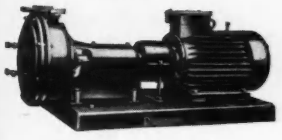


Filtration Plant in Gasworks

The illustrations show centrifugal pumps for light and heavy oil and liquor duties, stoneware and special metal pumps for handling acids and alkalis, pumps for circulating and washer duties, for clean water and fire services and for liquids containing abrasives.

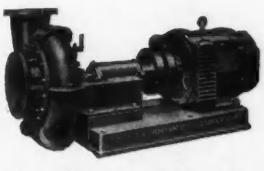


Rotary pump for Oil transfer duties.

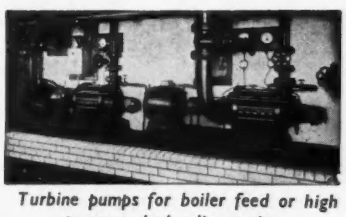


Stoneware pump for Corrosive and chemicals.

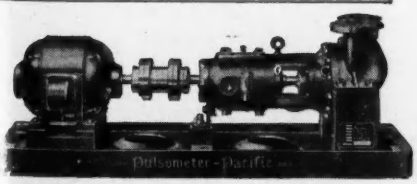
"HS" Type—for water services. All heads up to 500 feet.



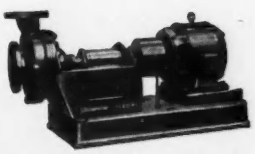
Slurry pump for coal washing and abrasive liquids.



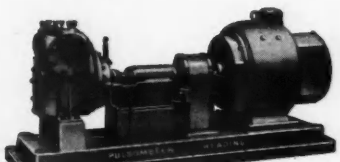
Turbine pumps for boiler feed or high pressure hydraulic services.



Pulsometer—Pacific type, based on latest American practice.



"JA" & "JB" types for high temperature water circulation.



Self priming centrifugal pumps.

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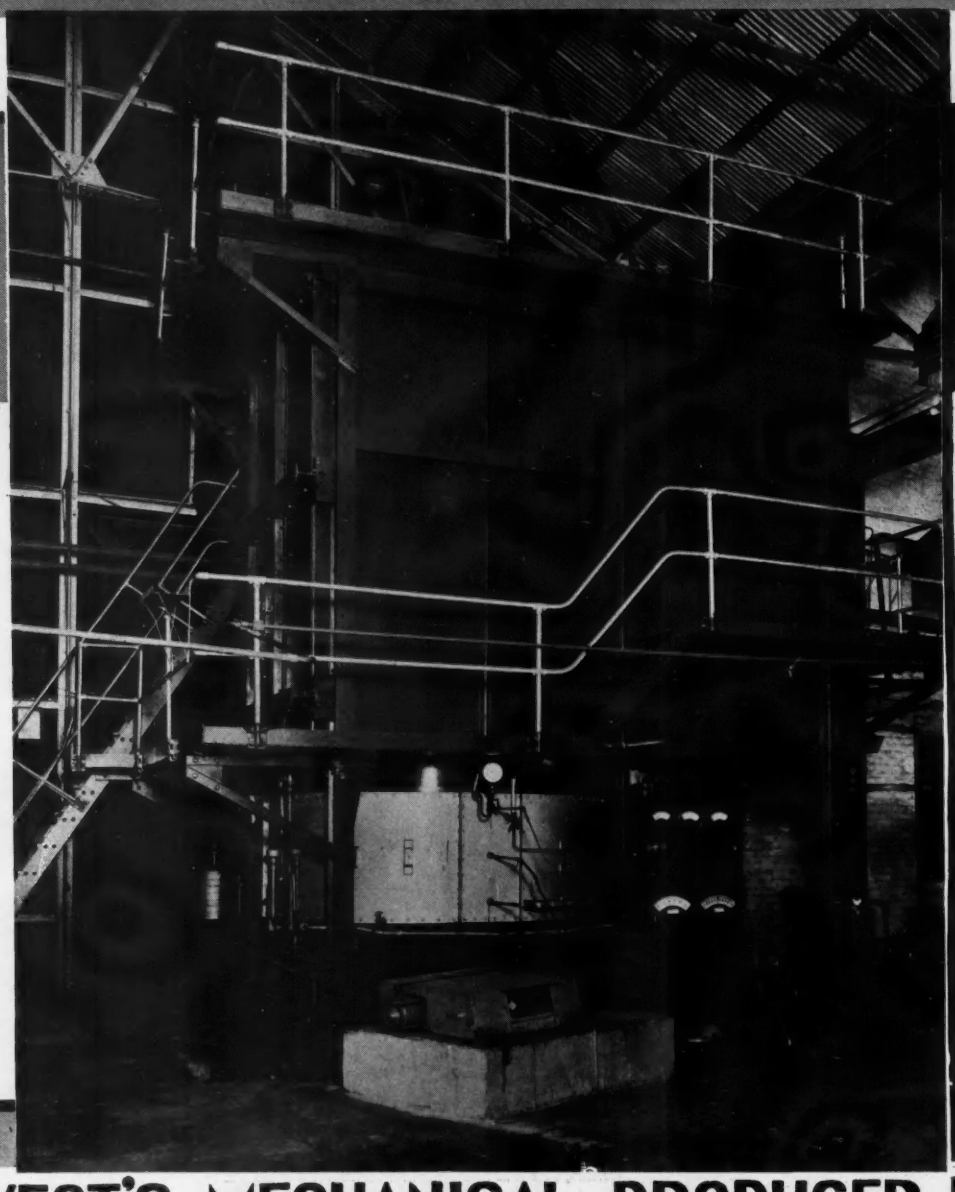

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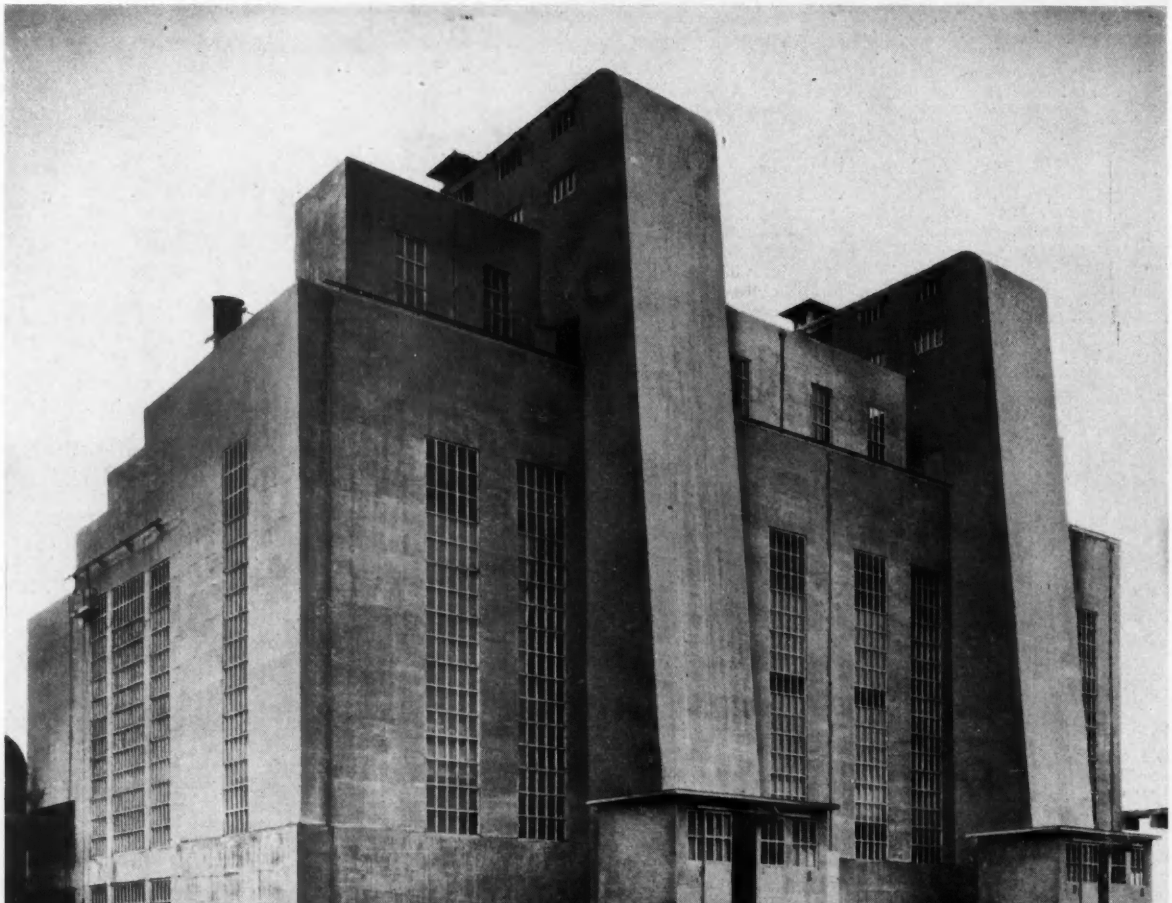

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New Carburetted Water Gas Installation at the Beckton Works of the North Thames Gas Board.

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degree. It was, therefore, of more than usual consequence that the gas itself should be of good quality, possessing a high theoretical flame temperature, and the failure of the producer to afford such a gas gave rise to the spectacularly high fuel consumption of 37.2 lb. per 100 lb. coal, combined with a combustion chamber temperature 150°C. below that necessary to maintain the coal throughput. The localised distribution of the blast through the fuel bed resulted in an excessive carryover of dust, which exceeded 2% on the fuel fed to producers.

This experience made it clear that if coke were to be gasified satisfactorily in mechanical producers such producers must be designed for the purpose, and the fuel used should be closely graded in order to ensure uniform distribution of blast through the fuel bed.

This record of work on the design and operation of external producers brings together in a depressing sequence the falsified hopes of successive experiments, but the lessons of this hard teaching are unforgettable.

Producer plant, particularly if equipped with mechanical grates, is far too costly to have its throughput reduced or its efficiency impaired by the use of low grade or badly sized fuel. Coke for producers should be closely graded, preferably between 2 in. and 1 in., and should not have been quenched with water having a high salt content.

Partial cooling and cleaning of producer gas costs a great deal in plant, in operating costs, and in the loss of sensible heat, giving little in return. Thorough cleaning, involving the recovery of waste heat as steam, cooling, washing, and treatment with electrostatic precipitators costs little more and gives positive benefits in operation and in the life of refractories, provided that the carbonising plant has a regenerative system capable of imparting the heat in the waste gases to the fuel gas and air, so ensuring a high flame temperature notwithstanding the loss of the sensible heat of the producer gas.

(D) CENTRAL PRODUCER PLANT: COKE OVEN BATTERIES.

In 1946 the decision was taken to install two batteries of Simon-Carves coke ovens at East Greenwich, with a total throughput of 1,000 tons of coal per day. In the general arrangements, provision was made for a future extension to double this capacity.

The heating system on this type of plant provides for full regeneration and a precise control of the admission of fuel gas. Both these conditions entail the use of a clean gas of consistent quality supplied at a constant pre-determined pressure. In these circumstances, the gas generated in mechanical producers using graded coke as fuel was the clear choice. As the works reconstruction scheme embodied the generation of electricity in a central power house utilising works steam pressure at 160 lb. per sq. in., it was specified that the producers should incorporate boilers capable of raising steam at that pressure, superheated to 500°F.

It was estimated that the carbonisation of 1,000 tons of coal per day in coke ovens would require the gasification of 125 tons of coke in producers. Deciding on a rating of 25 tons per day, the working requirement was five producers, with a sixth unit as standby. The Humphreys and Glasgow cold gas producer appeared to meet the general requirements. When operated on sized coke between 2 in. and 1 in., one unit was expected to make 5,400 therms of producer gas per day at a calorific value of not less than 122 B.Th.U., at a cold gas efficiency of not less than 75%. The steam to be raised at 160 lb. per sq. in. and superheated to 500°F. would not be less than 13 lb. per therm of gas made.

The producer consists of two annular vessels placed coaxially one above the other. They are connected by a nest of 180 × 3 in. dia. tubes, 2 ft. in length and arranged in three concentric rings. The diameter of the inner shell is 8 ft., and the fuel bed is contained wholly within the lower vessel, the supply of fuel being controlled so that the top of the fuel is always maintained below the top of the lower section of the boiler. The hot producer gas rising from the fuel bed has to pass, more or less radially, through the spaces between the tubes into an exterior annular jacket. the plates of which are insulated with 'Fosalsil' bricks. The inner surface of the jacket is also the outer shell of the boiler, an arrangement that offers additional heating surface. The gas travels within the annular jacket to the main outlet, whence it passes into the steam superheater. This superheater is rectangular in shape and contains a fourfold nest of tubes, thus providing eight parallel streams. The total heating surface of the boiler is some 660 sq. ft., and that of the superheater 240 sq. ft.

Since the upper vessel or steam annulus is only partially full of water, its inner shell plates must be protected against overheating, and a firebrick dome is constructed inside the inner shell, commencing near the bottom of the vessel.

The fuel for the producers is delivered to overhead hoppers by a series of inclined belt conveyors from the graded coke bunkers of the coke ovens. Storage is provided in excess of the maximum day's usage. Fuel supply to the producer is automatic, a pre-determined volume of coke being admitted through a sealed feed chamber at about 7 min. intervals.

Ash removal also is automatic, the grate revolving against a fixed plough, and the ashes thereby removed being discharged on to a system of belts, which carry them away to a main ash hopper capable of holding at least a day's production of ash.

The air blowers are in duplicate, the working set being motor-driven with a turbine set as stand-by. The air is automatically controlled to give 0.5 in. pressure at the producer top, and the saturation temperature is regulated by a suitable controller working on the admission of steam from a low-pressure main. The air and steam to the blast are measured and recorded.

Each producer is provided with its own scrubbing unit, which consists of an unpacked spray tower, a shallow layer of Raschig rings at the top acting as a spray arrester. The scrubbing water is withdrawn by local pumps from the river water supply main, and is delivered to the sprays at a pressure of up to 50 lb. per sq. in. The towers are 45 ft. high and 7 ft. dia. The cooled gas leaving the scrubbers passes through the boosters and is finally cleaned from dust and tar fog in Simon-Carves plate-type electrostatic precipitators situated on the roof of the machinery house. To aid the flow of the precipitated tar from the electrodes, tar oil is evaporated into the gas at the outlet of scrubbers.

In co-ordination with the automatic control of the producer blast, a second controller regulates the gas pressure on the supply main to the ovens and is actuated by the pressure in that main. This combined duty forms an exacting requirement, as it will be appreciated that, during the reversal of the heating gases in the oven wall flues, the demand for producer gas falls to 50% for a few minutes four times per hour. As the blowers and boosters are driven at constant speed, the volume control in each case is achieved by the operation of butterfly controls in the air main and the producer gas main.

The plant is in satisfactory operation, giving results in accord with the specified requirements, as is shown by the test figures quoted in Table 9.

In order to keep the producers at or near the rated load throughout the trial, four producers only were under blast. This gave a load of 27.05 tons of dry coke per day per producer, which represented an overload of 8.2% above the rated throughput of 25 tons per day.

The specification for the grading of the coke fed was 2 in. to 1 in., but the screening arrangements available at this time gave a feed containing 15.1% of fuel below the lower limit of size.

The rate of gasification obtained during this trial was

43.3 lb. of carbon per sq. ft. of grate area per hr. Had it been decided to install breeze burning producers it is doubtful from the evidence available whether much more than 10 lb. of carbon could have been gasified per sq. ft. per hr., in which case not five producers, but 20 producers would have been needed to supply the gas for the coke oven batteries.

The fuel consumption of the coke ovens supplied from the producers under these conditions was 11.04 lb. of coke per 100 lb. of coal, which represents a great advance on current horizontal retort practice at 17.1%, figures which become 9.8 and 13.4% respectively when the steam raised in the producer boilers and the retort bench waste heat boilers respectively is credited to the process.

TABLE 9.—*Operating Results with Humphreys and Glasgow Cold Gas Producer.*

Duration of test 7 days

Number of producers in blast, 4

FUEL: Coke Oven Nuts	As Fed	Dry
Moisture	8.5%	—
Volatile matter	1·8%	2·0%
Fixed carbon	78·7%	86·0%
Ash	11·0%	12·0%
Calorific value (gross) (B.Th.U. per lb.)	11,474	12,540
GRADING: 2½ to 2 in.	7·1%	
2 to 1½ in.	36·8%	
1½ to 1 in.	41·0%	
1 to ½ in.	12·4%	
Below ½ in.	2·7%	
Total coke charged to producers (as fed)	827·38 tons	
Total coke charge to producers (dry)	757·07 tons	
Dry coke charged to each producer per day	27·05 tons	
Dry coke gasified per sq. ft. per hr.	50·3 lb.	
GAS PRODUCED:		
Total steam supplied to blast at 16 lb. per sq. in.	807,000 lb.	
Blast saturation temperature	57°C.	
Producer gas made: Total metered	133,760,000 cu. ft.	
Calculated from Coke	133,000,000 cu. ft.	
Calculated from air to producers	134,000,000 cu. ft.	
GAS ANALYSIS (%): CO_2 5·7, CO 27·3, CH_4 0·4, H_2 10·6, N_2 56·0		
Calorific value (gross), 124·7 B.Th.U. per cu. ft.		
STEAM RAISED:		
Total steam raised	1,022 tons	
Steam raised per lb. dry coke to producers	1·35 lb.	
Average boiler pressure	155 lb. per sq. in.	
Average feed water temperature	154°F.	
Average superheated steam temperature	582°F.	

FUEL CONSUMPTION OF CARBONISING PLANT

Over a period of 15 weeks, dry coke ro producers averaged 2·207 cwt. per ton of coal carbonised.

Operation

The design engineer seeks to provide for the operating staff a plant which will permit the desired process conditions to be obtained. Equally, the operating staff have a responsibility for using the plant in such a manner as to justify the care taken in design. The high standard of the results obtained with horizontal retort plant arises from the understanding by each of the other's problems.

(i) *Heating up after Rebuilding or Repair Work.*

The fuel used during the lighting up of non-recuperative settings with built-in producers (the standard type of setting) is run-of-retort coke from which breeze has been removed. The rate of heating up is determined by the nature and extent of the repair work done. Settings newly built from raft level are usually heated up over a period of 42 days; settings that have had complete replacement of retorts and cross walls within the original main arches are heated up in 28 days, while lightly repaired settings may be brought from cold to working temperature in 10 days.

During the lighting up operation, temperatures nowhere in the setting are allowed to rise appreciably above 100°C. until all moisture has been driven off from the brickwork. Drying-out is hastened by providing, at the expense of increased fuel consumption, a large excess of air in the waste gases and by avoiding the use of water on the producer grate until it becomes essential in the later stages of the operation. The use of wet coke is avoided. No vents are left open at any point in the settings or flues, the whole of the waste gases passing through the main flues and chimney shaft.

After the settings have dried out care is taken to ensure a gradual, but continuous, rise in the temperature of the setting. Temperature measurements are made each shift, using base metal thermo-couples inserted into opposite sides of each combustion chamber at a level of 3 ft. above the nostrils. Optical pyrometers have to be used in the later stages when temperatures rise above the range of the thermo-couples.

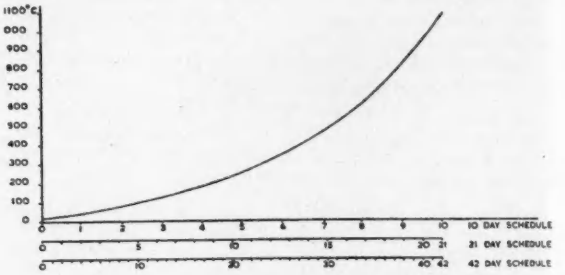

Fig. 4.—Heating up Curve for Repaired or Rebuilt Retort Settings.

(Note alternative time scale for use according to extent of repairs).

The essential requirements for heating up settings satisfactorily are:—

(1) An adequate drying period.

(2) A sufficiently large volume of waste gas at relatively low temperature to ensure a small differential in the temperature of the gases in their progress through the setting, and, therefore, correspondingly small differences in temperature of the refractory material.

(3) Close adherence to a predetermined schedule of daily temperature increments in the settings.

For many years settings have been heated up in accordance with the lighting up curve shown in Fig. 4. There is no theoretical basis for computing such a curve, but experience has shown the undoubted value of formulating a programme such as the curve represents and adhering strictly to that programme in bringing the setting to working temperature.

Until the change-over to gaseous firing, the level of coke in the producers is kept low, and to ensure that, at this stage, no unburnt producer gas goes into the setting, bricks are removed from the front wall to allow ingress of air to the tunnel below the nostrils. When the nostrils are sufficiently hot to ensure that producer gas will ignite immediately when it meets the secondary air, the fires are quickly filled with coke above the curtain wall, and the holes in the offtakes are bricked up.

In Table 10 average figures are given for the weight of fuel used in lighting up benches of 15 settings.

TABLE 10.—*Coke used for Heating up Settings.*

Days occupied in the lighting-up operation	Average Number of Tons of Coke (free of breeze) used for a Bench of 15 Settings		
	Total	Per day	Per setting per day
42	450	10·7	0·71
21	270	12·8	0·85
14	192	13·7	0·91
10	161	16·1	1·07

(ii) *Initial Charging of Retorts.*

Retorts are charged when the combustion chamber temperatures reach 1,100°C., but before charging commences the hydraulic mains, collecting mains, governors, etc., are purged with waste gas of good quality. Where waste gas is not available the air in the system is displaced by town gas. A

less satisfactory method is to charge a few retorts and use the gas so generated to purge the top work.

Immediately following the purging operation, charging is commenced and proceeds in accordance with the following schedule:—

> During the first 24 hr., each of the five rows of retorts in the bench of settings is charged at intervals of 4 hr. For the following three days the bench is operated with a carbonizing period of 20 hr. followed by a further three days with a 12 hr. carbonising period. The standard carbonising period of 10 hr. is then put into operation.

Advantage is taken of the period of low throughput to carry out tests of producer gas and waste gas and to make adjustments of dampers and primary and secondary air slides to ensure that the settings are evenly heated and that the excess or deficiency of secondary air is reduced to a minimum.

(iii) *Variation of Gas Output.*

The stations that now comprise the Metropolitan Division of the South Eastern Gas Board have been in the unique position, among large works, of depending solely on horizontal retorts for the production of town gas. Variations in the demand for gas can be met only by varying the output of the settings. Notwithstanding the wide and rapid variations thus necessitated in operating conditions, a high standard of efficiency has been maintained, and the length of life of the settings has been satisfactory.

Variation of output is achieved by one or other of the following methods:—

(1) By increasing or decreasing the length of the carbonising period. It is convenient to limit the number of carbonising rates to 10, 12, 13.3, and 20 hr.

Fuel consumption setting with different carbonising periods is approximately:—
10 hr. carbonising period: 3.4 cwt. per ton of coal carbonised.
12 hr. carbonising period: 3.6 cwt. per ton of coal carbonised.
20 hr. carbonising period: 4.0 cwt. per ton of coal carbonised.

(2) Adjustment of gas output is frequently effected by 'standing by' a proportion of the working settings. When gas has ceased to be evolved from the retorts, the collecting mains are isolated from the high-vacuum system and maintained under pressure by waste gas or town gas. Cold coke has to be supplied to the producers at intervals of 4 hr. It was once the practice to use the hot coke remaining in the retorts in standby benches to replenish the producers, but this practice was discontinued because it increased the rate of heat loss from the mouthpieces of the retorts left empty. The temperature maintained in the combustion chambers during standby work is approximately 1,000° to 1,100°C., and the fuel consumption per setting per 24 hr. is approximately 0.8 ton of coke.

There appears to be little difference in the overall fuel consumption between these two methods. Method (1) is slightly more economical in labour, but method (2) has the advantage that gas output can be increased and decreased more rapidly than by the alternative method. Occasionally, heavy demands for gas have made it necessary to shorten the carbonising period to 9 hr. and, less frequently, to 8 hr.

(iv) *Temperature Control.*

To obtain satisfactory working results, the settings must be uniformly heated and maintained continuously at the desired temperature. Great care is taken to ensure that combustion chamber temperatures are maintained at the required standard. The maximum and the minimum temperatures of each chamber are determined once each shift. If the maximum and minimum temperatures of any chamber differ appreciably, an investigation is made to determine and deal with the cause of the variation. The higher of the two temperatures is accepted as the working temperature. Temperatures are never taken while producers are being clinkered, nor while draws are taking place. Lists of the temperatures of the settings are supplied to the heat control staff, who make adjustments to any setting in which the determined temperature is found not to be within ±15°C. of the prescribed working temperature.

The normal combustion chamber temperatures employed for various carbonising periods are as follows:—

Carbonising Period (Hr.)	Temperature (°C.)
9	1,370
10	1,350
12	1,320
13.3	1,300
20	1,250

Occasionally, the temperatures have to be raised or lowered slightly in order to control the volatile matter left in the coke charges, because if the coke produced is to be suitable for use in domestic appliances the residual volatile therms should not fall below 2.5 therms per ton of coke.

The fused dust in all nostrils and secondary air ports in each chamber, and the dust in the jack arch flue are removed at scheduled intervals. Upcast flues are freed of adhering dust, and dampers are moved, cleared of dust, and reset each week.

To minimise fluctuations in chamber temperatures, producers are replenished with fuel at each draw, and clinkering is carried out in stages. (For example, where a pair of producers serves three settings it is done in four stages, half a fire being cleared every 4 hr. and the cycle completed in 16 hr.).

(v) *Retort Pressure Conditions.*

To attain high yields of gas it is essential that the retorts and fittings shall be as gas-tight as possible and that loss of gas through joints and cracks should be reduced to a minimum by avoidance of pressure in the retorts as far as possible.

Hydraulic mains with dip pipes sealed to a depth of 1 in. cause violent pressure oscillations in the retorts, due to the intermittent nature of the flow of gas through the liquid seal. The oscillations are too rapid for measurement by ordinary means, but are certainly greater than ±5/10 in. from the average point. To avoid momentary pressure in the mouthpiece, therefore, an average pull of 15/10 in. in the hydraulic main is required.

Pressure in retorts can be minimised by attention to the following details:—

(*a*) Unfailing use of the auger each time the retort is discharged.

(*b*) Use of an auger of the correct size—*i.e.*, within ½ in. of the nominal internal diameter of the ascension pipe. Wear is sufficiently rapid to necessitate the replacement each week of worn augers by reconditioned ones.

(*c*) Regular inspection of hydraulic mains to detect 'tilting' and consequent unequal sealing of dips.

(*d*) Maintenance of a supply of tar-free liquor to the hydraulic mains. The rate of supply should be kept constant by means of calibrated nipples and a constant head of pressure.

(*e*) Periodic cleaning of equilibrium pipes to tar and liquor overflows on the hydraulic mains.

(*f*) Avoidance of stopped ascension pipes or dip pipes, which, if the retorts are well filled, is most generally

due to the inleakage of air at doors and mouthpieces and partial combustion of the gas and tar inside the pipes.

Too hign a pull may be equally objectionable, particularly if leakage exists at the ends of the retort. If the leakage is in the hot portion of the retort, waste gas will be drawn in and much of this will be converted into producer gas, to the advantage of the gaseous therm yield. The best operating condition is that which gives rather more than level gauge at the mouthpiece. Benches equipped with scrubber standpipes and Askania controlled butterfly valves to maintain constant pressure conditions have been installed in order to overcome the difficulties associated with ascension pipes, hydraulic seals, and governors.

(vi) *Maintenance.*

A retort patcher follows the discharge of each retort once per day and deals with any cracks or spalling at the retort ends. Damage done to the retorts by the excessive local heating that results from the combustion of leaking coal gas in the heating flues is much more serious than the pecuniary loss due to leakage of gas. Periodically, the governors on each bench are set to put pressure on all retorts, thus allowing the maintenance staff to observe and record the position of all leaks from retorts, mouthpieces, ascension pipes, dips, or collecting mains As an additional control, the calorific value and specific gravity of the gas from each retort house are recorded continuously, and determinations are made daily of the inert constituents.

Advantage is taken of the period of rebuilding and repairing carbonising plant to overhaul mouthpieces and doors. Where necessary, doors are removed and the knife edges are machined and tested for accuracy with feelers on a surface plate. The flange on the mouthpiece is skimmed *in situ* by means of a portable refacing machine. After the door is refitted to the mouthpiece a final test with feeler gauges is made. Full time door fitters are engaged on working settings; each retort door lever is removed and lubricated each week, and any leaking door is given immediate attention. Should it not be found possible to deal with the leak by adjustment of the eccentric bolt or by resetting the cross bar, the faulty door is replaced.

Improved Refractory Materials

As a result of the improvement in the quality of refractory materials that are used in the construction and repair of settings, and the great care taken both in the lighting up of settings and the employment of moderate carbonizing temperatures (maintained within narrow limits), the life of settings has increased greatly during the past 30 years.

(vii) *Weight of Charge.*

Heavy charges should be laid, and well backed up clear of mouthpieces. With a standard retort 20 ft. in length and 21 in. × 15 in. oval section, the best overall results are obtained when employing charges of 13.5 to 14 cwt. Among the advantages claimed for heavy charges are:—

(*a*) Reduction in labour costs per therm made.
(*b*) Economy in fuel consumption.
(*c*) Efficient tar cracking conditions.
(*d*) Minimum production of naphthalene and scurf.
(*e*) Fewer stopped pipes.

The figures below indicate the steady increase made in the charge weights during the last 30 years at the East Greenwich Works.

Year	Weight of Coal Charge (Cwt.)
1920	10.5
1935	11.6
1950	13.7

(viii) *Formation of Scurf.*

The scurf layer plays a very important part in the carbonising process. Until a thin layer of carbon is deposited on the surface of the retort, charges are difficult to push and it is impracticable to discharge retorts quickly enough to maintain the normal charging schedule. The sealing effect of the scurf layer also reduces the loss of gas that would otherwise occur.

On the debit side is the damage done to the retort surfaces and joints by the chisel-ended tools if the retorts are hand scurfed and the serious loss in throughput that takes place at an increasing rate as the carbon layer grows in thickness at the expense of the space that should be available for coal. Freshly deposited carbon adheres firmly to the retort and remains so while it is still a thin layer, because in this condition the temperature difference between the carbon and the retort is small. As the carbon layer thickens, the temperature difference between the retort and the scurf is likely to increase greatly, particularly when wet coal is being charged. The difference in the expansion coefficients may cause separation of the two layers. The gas space so formed greatly restricts the rate of heat transmission to the coal.

Unless all the retorts in the same row have the same thickness of carbon deposit, charges of uniform length and cross-section cannot be laid in each retort because it is impracticable to adjust the coal feed on the charging machine to suit individual retorts, and the coal charge must be reduced to suit the most heavily scurfed retort.

In order to avoid these serious effects on process efficiency, but to retain the advantages of easy pushing and gas tightness, the controlled removal of scurf by combustion methods was investigated. It was found that when a retort was left empty for 2 hr. once each week there was sufficient air movement through the retort to remove by oxidation as much scurf as will normally be deposited in a week. In a minority of cases it is necessary to aerate the retorts more or less frequently than once per week to maintain the correct thickness of scurf. By careful attention it is possible to maintain a minimum layer of scurf, thus providing for the maximum weight of coal charge and for the easy discharge of the coke.

Compared with hand scurfed retorts, the rate of gas leakage from freshly aerated retorts is much smaller, and returns to the normal rate more quickly, but it must be borne in mind that retorts need hand scurfing once only each 90 days, whereas aeration is carried out each week. The overall loss of gas may therefore be no less when aeration is adopted, but the advantages in working and the continued high throughput maintained entirely justify its adoption.

(ix) *Control of Calorific Value.*

The practice of adjusting calorific value by over-pulling was abandoned 25 years ago. Control of calorific value is carried out by dilution with washed waste gas or producer gas. The diluent is admitted to each of the coal gas streams at a point on the inlet of the exhauster by means of hydraulically operated distant control valves.

A control panel provides an extensive range of recording instruments, and from the indication of the continuous record of the calorific value of the diluted coal gas on any stream the operator is able to regulate the volume of waste gas added. No control of calorific value is attempted in the retort houses, gas of high calorific value always being made. Since the calorific value being recorded is that of the diluted gas, the method of control is safe and direct, no calculations being required. The calorific value to which the operator is instructed to work is decided by the amount of air that is being added to the purifiers and also by the degree of benzole recovery being practised.

A system of automatic calorific control has been developed and is in use at one works. A Fairweather calorimeter records the calorific value, and the resistance thermometers of the calorimeter form part of a bridge circuit. When this circuit is not in a state of balance the output signal produced is amplified and made to operate a phase-sensitive motor, which is coupled to a sliding resistance that moves to restore the balance in the circuit, and in doing so opens or shuts the dilution gas valve as required.

DISCUSSION

Mr. W. K. Hutchison (South Eastern) remarked that it might be true, as the authors pointed out, that the final development of horizontal retorts bore many features closely resembling a solution propounded by Carpenter in 1886. This was not stated so clearly in the paper concerned, but in an editorial in the *Gas Journal* in that year, it was stated: 'It will, of course, be conceded that, although the waste gases from these settings do not heat the incoming air, they are yet made distinctly useful, being interposed as a screen between the outer wall and the body of the setting, thus to a considerable extent preventing radiation of live heat.' But they must remember that in the interval since that paper was published, there had been vast improvements in working conditions brought about by better ventilation and perhaps, as a single issue of great importance, by the introduction of Fleuve systems for removing hot coke. Therefore, as he saw it, one of the reasons which prompted Carpenter to seek an alternative method of heating to the built-in producer might no longer exist; but he did think that the experience gained in the development of external producers, so carefully described by the authors, had been of the utmost value in gaining a clearer understanding of the fundamental requirements of heating systems. The logical outcome of this work was recorded in the section of the paper dealing with the results of the new mechanical producers associated with the coke oven plant at East Greenwich.

Heat Insulation

If there was one other point in design which might well receive the attention of designers in other plants, it was the description of the method of insulating the sub-structure of a carbonising plant from attack and damage due to heating.

Returning to the horizontal retort system, he felt sure that the authors' advocacy of the use of the jacketed setting would not pass completely unchallenged, and he trusted that they would hear in the discussion the views of those who still maintained that recuperators were the better solution.

He suggested that there was perhaps a too ready acceptance of retort coke as a suitable fuel for heating retorts, bearing in mind that one-quarter of the potential heat value of that coke could only be recovered in the form of waste steam. This coke had, for all practical purposes, been degraded into breeze. He had been interested in the results being obtained with outside mechanical producers using breeze. He wanted to make it clear that when he said 'breeze' he meant breeze—50% under ¼ in. The usual criticism of such plant was that it required to be very much larger, and this must be admitted with regard to the dimensions of the generator, but not to those of all the ancillaries, which represented a large element of the total cost.

Another criticism was that the producer gas must be cooled and cleaned, but this had its own advantages.

A third criticism—and this was more difficult to answer—was that it was impossible to achieve the extreme simplicity of design that the authors had described in their jacketed setting. Recuperators were, of course, then necessary. Without attempting to go more deeply into this subject, he would only say that, even taking account of the additional capital cost, it appeared that with the present values for coke and breeze, there was a case to be made out for using breeze at least in part of the heating equipment.

Market Fluctuation

Most important, perhaps, of all to those who had or who had had responsibility for marketing breeze, it might enable the industry to be independent of an outside market which was known to fluctuate violently and not to be under the control of the producer in any way. He hoped that, either in contributions to the discussion that day or in the written discussion, or perhaps by publication later, they might hear a little more about this interesting experiment.

He would like to draw one last conclusion from the results published in the paper. As Mr. Stott said, the practice of the South Metropolitan Gas Company was to build its own carbonising plant. It did seem unlikely that that practice would continue in the future. But there was one part of the practice of the South Metropolitan Gas Company (and it was, of course, not confined to that Company alone) according to which each new plant was the subject of careful study in its performance with the object of incorporating the lessons learned in one unit in the design of the next.

The Gas Board was a unit large enough to carry a technical staff and to own sufficient units of gas-making plant for that technical staff to be thoroughly acquainted with the detailed performance of the plant. The experience thereby gained, recorded, and analysed should be of the utmost value to the contractors, in friendly co-operation, for the effects of development to be carried through to their logical conclusions, and, he might add, for the clarification of problems suitable for investigation by the research units of the gas industry.

Mr. W. S. Hubbard (Liverpool) said that the general opinion of most was that the horizontal retort was doomed, but if one bore in mind the high capital cost of new carbonising plant and the fact that existing horizontal installations would have to run for many years, then information which could be used in the rebuilding of existing arrangements was welcome. Today approximately 42% of the coal carbonisation in this country was carried out in horizontal retorts.

Re-building Worth While

Experience indicated that the rebuilding and altering of existing horizontal installations and at the same time introducing mechanically made producer gas had been worth while.

In the paper reference was made to the experience with regenerative settings fired with producer gas. In August next, they in Liverpool hoped to put to work their first installation of horizontal retort chambers fired with cold producer gas which had been cleaned to the last degree electrostatically. The design of the settings was similar to that used in first-class coke oven practice. Apart from the improved working using mechanically made gas, the amount of information gained on both horizontal and vertical retorts had been enormous, in addition to which there had been many other side dividends.

The experience which the South Metropolitan Gas Company had in regard to the use of mechanical producers was extremely limited and was carried out in unfavourable conditions. Yet he confessed that a wider publication of the information in regard to retort alteration and practice would be helpful all round.

It seemed from the authors' figures that mechanical producers were condemned out of hand. Yet for coke ovens they gave the extraordinarily low fuel consumption of 11%. This indicated that the coke oven in large instuallations was inherently one of the most efficient of all carbonising plants, presumably due to the high throughput in relation to its volume, thus reducing the incidence of external heat losses, and probably the fact that on such a large installation the provision of adequate recuperation was a small proportion of the total cost. The many advantages in terms of fuel consumption when using hot gas from mechanical producers had led to many attempts to do this. The difficulty was the question of dust. The experimental work at Liverpool indicated that with the particular layout involved, the problem was inseparable.

Jacketed Settings

The paper sought to show that the jacketed setting possessed overwhelming advantages in respect of throughput. It should be pointed out, however, that the systems taken for comparison were ill chosen, since the recuperative settings with which the comparison was made were fed with gas from external producers and they were penalised from the start with a relative loss of 14%. It would have been more relevant to compare jacketed and recuperative settings both fired by the same type of producer—*i.e.*, the built-in type or mechanical. The horizontal setting with built-in step grate producers and full recuperation was by far the most common type in this country, and their performance could be assessed from the data given in the paper. It could be inferred that had the recuperative setting been fired by built-in producers, the heat available for the carbonisation of the coal would have been 49%, which showed a significant advantage over the jacketed setting.

In these circumstances, if it was assumed that the fuel consumption of the jacketed setting was 18% by weight of the coal, then on the same basis the consumption of the full recuperative horizontal setting with built-in producers would be in the region of 15% by weight of the coal. This figure was believed to be attainable with such a setting when efficiently operated and the figure was in good agreement with that quoted by Pexton for the same conditions.

The advantage possessed by the fully recuperative setting in respect of fuel consumption and/or throughput had to be offset against somewhat increased capital charges for a more complicated setting. If the figures for capital charges given were

adjusted for this, the relative cost of a fully recuperative setting as against the jacketed setting was as 130 to 100, and the case for the jacketed setting was problematic. It might be claimed that the jacketed setting would give more even heating, but if it was accepted that uneven heating was frequently the result of insufficiently high flame temperature, then the fully recuperative setting would certainly not be deficient in this respect. Recuperation above a certain level would have as beneficial an effect on the attainable flame temperature as jacketing.

No advantage had been claimed for re-circulation methods unless it was additional throughput at a disproportionate cost in fuel consumption. Experience at Liverpool had suggested that re-circulation was a doubtful proposition, and where it was practised the extent must be limited. It certainly resulted in more even heating of the retorts, but the carbonising periods were not significantly reduced at comparable combustion chamber temperatures. With unlimited re-circulation, the fuel consumption might be profoundly affected. It would also appear to be inadvisable to apply re-circulation to settings fed with cold producer gas where the recuperation was limited and the attainable flame temperature tended to be low. In such circumstances the fuel consumption might rise to unreasonable levels before satisfactory carbonising temperatures were attained.

In Liverpool four benches of horizontal retorts were fired with cold producer gas with recuperation on both producer gas and air. These settings were supplied with fuel gas from mechanical producers running on nut-sized coke and the fuel consumption over an extended period amounted to 19.5% by weight of the coal carbonised. If allowance was made for a small amount of waste heat steam also raised, the net fuel consumption was 17.5%. Considering the fact that these settings sunered all the losses associated with external producers, they compared favourably with the jacketed setting and the gas supplied to them was completely cleaned.

Step Grate Producers

The step grate producers of the modern type described in the paper were regarded by the authors as satisfactory. But the calorific value of the gas was comparatively low and the gasification rates high. In general, the most trouble-free installations of modern step grate producers were attached to vertical retort installations. This was largely due to the low fuel consumption of such installations, combined with the comparatively large ground space available for the producers. As a result of these factors, gasification rates in excess of 10 lb. of coke per sq. ft. per hr. were seldom called for. In these conditions, the producers gave no trouble of any kind, and it was confirmed that the quality of the gas was consistent and of higher calorific value and lower in temperature. It would be of interest to know whether the higher gasification rates given by the authors gave rise to dust troubles in the setting, in spite of the large settling chamber provided. Certainly with continuous vertical retort step grade producers of the most modern type, dust troubles were negligible and re-lining of the producers themselves was only necessary after extended periods of operation. The preference for water feed to the producers described would also account for the comparatively poor quality of the gas. It might be claimed that this poor quality was offset, in part, by the high temperature of the producer gas, which was nearly 200°C. higher than experienced with vertical retorts.

The use of external step grate producers quickly led to an increase in the gasification rates, and this was followed, as might be expected, with difficulties with the dust carried in the producer gas. The position was further complicated by the attempts to use breeze in the producers. This experience with the single mechanical producer appeared to have been unfortunate.

There was emphasis on the moisture in the coke, but with coke containing even 20% moisture, the calorific value of the resulting gas could not be reduced by much more than 5 B.Th.U., and unless operation conditions were close to the limit, this should not be significant. (The operating results for the mechanical producer did not indicate why such poor results were attained, and it would be interesting to know the respective temperatures of the producer gas and air entering the combustion chambers.)

It was not established that the conclusions drawn from this experience were justified. There were a number of installations at work which utilised hot semi-cleaned gas with complete satisfaction both in horizontal and vertical retorts. There were certain difficulties attendant on feeding semi-cleaned gas to settings via recuperators, since the small amount of residual volatile matter in the coke was sufficient to give trouble with the deposition of fine deposits in the recuperators. These deposits arose from the cracking of the tar, and the sticky nature of the product supplemented the deposits of fine dust which could not be completely removed by partial cleaning.

Mr. K. L. Clarke (W. J. Jenkins & Co., Ltd.) remarked that the paper claimed that it was 25 years since the practice of adjusting the calorific value of the gas by overpulling was abandoned. This statement needed qualification, as in the last 25 days he had been to more than one works where this practice was in operation.

Dr. F. J. Eaton (North Thames): About 3½ mill. tons of our coke is made from horizontal retorts. The principles of quenching are well known. The first principle is that a controlled quantity of water should be spread over the surface of the coke as evenly as possible. The second is that provision should be made for drainage of the surplus water from the coke. The third is that the run of retort coke should remain in the container sufficiently long so that the under-quenched and hot large pieces have a chance of removing the water from the smaller over-quenched pieces. Those principles are met by the very primitive system first described in the paper, in which the coke is discharged into a container with a perforated bottom and sides. With that system of quenching you can get the figures which are recommended for coke quality in the Coke Quarterly Report issued by the Gas Council. Those figures are 3% to 8% for broken coke and 3% to 10% for coke boiler nuts.

The Fleuve System

The system, of course, is not a very good one in that the amount of labour required is high, and therefore other systems have been evolved. I think that the authors are correct in stating that the Fleuve system is possibly the best for horizontal retorts. They have gone fully into the reasons and the design of that particular system, but I should have liked to have seen them being rather more definite as to the length of the Fleuve trough. We have gone into this in a Coke Preparation Panel which was set up by the London Counties Coke Association under the chairmanship of Mr. Webber; and the paper suggests that 264 ft. is the maximum figure for design of a Fleuve system. I should like to read what has been put in the Coke Preparation Report, because that suggests that 150 ft. is the maximum. It states: 'It is difficult to determine the exact immersion period required for the coke particles of different sizes, but it has been found in practice that where the velocity of water flow is 10 ft. per second, the travel of coke should be a maximum of 150 ft. and a minimum of 50 ft. The following table shows the influence of length of coke travel and moisture content of the coke when the velocity of water flow is 10 ft. per second'—and that table shows quite clearly that the length of the trough should be about 150 ft.

The other point about the Fleuve system which is well brought out in the paper is the importance of the design of the extracting mechanism. I think that our Panel came to the conclusion that a wheel was possibly the best method to use, because you can vary the rate at which the wheel moves and therefore can have some form of flexibility.

Many of our horizontal retort houses are equipped with drag-bar conveyors, and that, of course, contravenes all the principles of quenching. You have to use a very large quantity of water on the stage, larger than is necessary, first in order to give good conditions in the retort house and secondly in order to protect the trough from cracking. It is also difficult to provide adequate drainage. For these reasons I think that many people get discouraged and do not bother about the moisture content of the coke from systems of that sort. I think that is a great pity, and I think we can do very much better if we try to show the operator in such a retort house that he can get better results.

Mr. G. Dougill (North Thames) said that in the North Thames Board's area they had many horizontal retorts, but they got good results from them, although they used recuperative settings rather than jacketed settings. They had nine retort houses at Beckton, and they could re-set one per year, and they developed their setting to suit existing conditions. They tried to avoid any patching. The amount of cold patching that was indicated in the paper horrified him. Cold patching was really wrong, because when one designed a setting with expansion allowances, these were taken off on the first heating and on cooling down they naturally did not open. The shrinkage on cooling was compensated for by large numbers

(*Continued on p. 820*)

NORTH THAMES DISTRIBUTION DEVELOPMENT*

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THE South Western division and the Chertsey district of the North Thames Gas Board may conveniently be divided into sub-areas consisting of the developed towns and their suburban fringes, the large towns being Uxbridge, Hayes, Slough, High Wycombe, Windsor, and Maidenhead, and the smaller Amersham, Beaconsfield, the Chalfonts with Gerrard's Cross, Marlow, Yiewsley with West Drayton, Ascot with Sunningdale and Sunninghill, and Chertsey with Addlestone.

A. D. L. COPP.

Table 1 gives statistics of population in the built-up areas, annual gas sales, and estimated maximum rates of gas demand in 1949, together with the total population, from which it will be observed that the great majority of persons live in well defined townships. It should be noticed that there are in this area very widespread tracts of unspoiled agricultural land and areas of woodlands and heaths, and the first step needed was to ascertain the intentions of housing authorities and others in land development. Fortunately, with the exception of parts around Maidenhead, the Greater London Plan of Professor Abercrombie gives what is hoped to be a reliable peep into the future.

The Abercrombie plan is wonderfully comprehensive, covers every natural feature and development, discusses population distribution, decentralisation, industry, communications, agriculture and land classification, open spaces, and all pertinent subjects. There have been six years in which to observe the extent to which the various authorities subscribe to its findings and recommendations, and it is fair to say that with the exception of execution of the plans for new roads (which appear to be indefinitely postponed) the recommendations are being adhered to. It has been noticeable that at various public enquiries and meetings of authorities the Abercrombie plan has been treated with the respect it deserves, and its recommendations mostly upheld, or but slightly varied.

Of particular interest to the North Thames Gas Board are the figures showing annual population increases by migration, decentralisation and resettlement, the number of persons who can be housed on vacant frontages in the suburban ring, and the ultimate sizes of towns and villages.

Migration and decentralisation are of importance because by study of statistics it is possible to estimate the number of each social class of persons who will move into particular districts. The revenue per consumer that may be expected is intimately bound up with the social status of that consumer. For example, a higher-income middle-class consumption may be 250 therms annually, an agricultural labourer's being 40, and with a 6 to 1 difference in consumption one may expect a 3 to 1 proportion in maximum demand rate.

Armed with the information in Table 1, and with a survey of industries within the area, a description of each township or 'industrial group' was prepared, an example of which may usefully be quoted:—

'HIGH WYCOMBE.—1938 population, 33,000. Planned population, 48,500. Ancient town on London-Oxford road and main-line railway. Rural surroundings 30 miles from London. Early industry, chair making, but now also furniture, bedding, polishes, plywoods, precision engineering, and paper. Modern building has sprawled over the hillsides, with considerable waste of land. Abercrombie deprecates further industrial expansion other than furniture, and clothing (to employ women). The whole place seems prosperous. Existing maximum week, 14 mill. cu.ft.

TABLE 1.—*Statistics of population, development prospects, and actual and estimated gas loads.*

Municipal Area or Parish	Intentions of Greater London Plan Regarding Development	Population in Built Up Areas, 1938	Population Proposed	Proposed Average Density (Persons per Acre)	Gas Sold in 1949 (Cu. ft.)		Estimated Requirement of Gas for 1970 (Cu. ft.)	
					Annual (Mill.)	Maximum Hour (Thous.)	Annual (Mill.)	Maximum Hour (Thous.)
Uxbridge, Cowley	No further industrialisation ; negligible development.	16,250	17,000	17	192	165	400	350
Hillingdon	Filling in and rounding off	24,500	29,000	15½	144	135	300	280
Hayes—Harlington ...	No expansion	49,000	52,600	28	424	240	850	480
Slough...	New industry encouraged ; increased population.	50,600	110,000	24½	762	300	3,000	950
Yiewsley—West Drayton ...	No development	12,000	12,500	24	158	152	300	300
Staines—Ashford	No development of Staines ; housing development at Ashford.	25,500	30,000	16	41	32	90	70
Part of Ascot area	No development other than Bracknell new town	10,600	35,000	12	393	170	1,000	430
Windsor	Little expansion	19,400	20,500	17	282	120	450	190
Eton	No extension	4,000	4,000	24	41	32	65	50
Datchet	No extension	3,000	3,000	8	29	26	50	40
Gerrard's Cross—Denham, with Chalfonts.	Film Studios may expand ; no factories ; a little filling up of frontages.	11,500	14,500	14	149	133	450	300
Beaconsfield	No further industry ; considerable housing ...	5,500	8,500	9	65	62	200	100
Amersham	None in old town ; filling in in New Town ...	6,000	7,500	8	84	88	175	180
Chorley Wood West ...	Filling in and rounding off	800	1,800	12	2	—	9	12
High Wycombe	Out of bounds to new type of industry ; housing development.	34,000	48,500	14	331	180	1,250	600
Maidenhead—Marlow ...	Without the region covered by the Greater London Plan.	—	—	—	—	—	—	—
Chertsey and district... ...	A plan for extension is contemplated	26,000	39,000	25	310	135	600	300
		298,650	433,900		3,407	1,970	9,189	4,632

Topographical and Other Considerations.—Any or all conclusions based upon a study of townships may be qualified by the effects of town-planning, communications, agricultural needs, etc.; and in particular, because of the enormous capital cost of railways, it is safe to exclude from expansion any ill-served place, however attractive it may be from every other point of view.

Four Rings of Development.—The structure of the Abercrombie plan is based upon four concentric zonal rings. The first and second rings do not concern us here, except to note that 415,000 persons are to be displaced from the inner urban ring, and that 386,000 of them are to be put into the second

* Abstract of I.G.E. Communication No. 368.

ring by the filling up of vacant frontages. The third, or Green Belt ring, proposed in the plan is intended to be about five miles wide, and the development is to be confined to existing towns, but strictly limited. These towns include Chertsey, Egham, Sunbury, Staines, and Uxbridge. Villages within the belt are numerous—*e.g.*, Yiewsley, West Drayton, Harlington, Cranford, Iver, Gerrard's Cross, the Chalfonts, and Chorley Wood Common, also around Ruislip Mere.

The fouth is the Outer Country ring, so far relatively undeveloped except at Slough, the land being predominantly agricultural. It is intended to build one new town (Bracknell) and to enlarge suitable inhabited places, while preserving the best agricultural lands. There is no well defined outer limit to this ring.

Redistribution of Population.—According to Dr. Enid Charles in the Barlow Report†, the population of the City of London and Metropolitan police districts was 8,655,000 in 1937, 9,136,000 in 1941, and will fall to the 1937 figure by 1971.

Of these persons, 935,000 will be moved out, or will move themselves out,

(1) To quasi-satellite towns	125,000
(2) Additions to towns in the outer country ring	261,000
(3) Additions to towns outside the outer country ring	163,750
(4) Eight new satellite towns	382,250
	935,000

The possible increase in the area now being considered for each of the above is:—

(1) 40,000. (2) 70,000. (3) *Nil.* (4) 24,000.

The proposed extension of built-up areas includes Amersham, Chorley Wood, High Wycombe, Beaconsfield, Gerrard's Cross, Ickenham, Southall, Slough, Windsor, Egham and Chertsey.

Industrial Prospects

As a result of hostile bombing during the 1939-45 war, much Metropolitan industry migrated to Maidenhead, Slough, and High Wycombe; these towns appear to be the most attractive centres for future industrialisation. We must presume there will be little new industry in the green belt, or expansion in such areas at Hayes and Harlington, both of which have a permanent house shortage. On the whole, it may be said that considerable expansion of industrial gas sales will be confined to the above towns, plus Staines and part of Chertsey.

Communications.—One thing is certain, that ribbon growth along any future highways will be discouraged; hence, it is not necessary to connect the route of a new road with any kind of development. It seems certain that the extension of the distributing and trunk main could not await construction of the new roads that have been proposed. The Abercrombie plan also discusses waterways and railways, and it is felt that the light trades that predominate in the Uxbridge districts are not tied to sites alongside these, and there is no prospect of new railways being built, on account of the great capital cost.

Airports.—Airports are regarded as future important gas consumers, and within the Board's western area there are the London Airport at Heathrow, Northold, and White Waltham (minor) for civil uses, and the airfield at Langley, near Slough. Many factories are already developing west of Heathrow, which will be unique in its busy-ness. Its potentialities as a consumer of gas merit much careful thought.

Agricultural Interests

So large a portion of the Western division of the North Thames Gas Board is of good agricultural value that some study is desirable to consider where the board is most likely to have to provide for future development on poorer soils. The poorer land extends in a wide belt about a south-west to north-east axis through High Wycombe, and is almost without railway communications, except through High Wycombe and the extreme north and south of the belt; and again around Bagshot and south of Bracknell, which latter is a satellite town site. Medium-quality farm land covers the extreme south-west except the parts in the preceding sentence, while good and intensively cultivated land covers a great area around Windsor, Slough, Maidenhead, and south and south-east of Uxbridge to Chertsey. It seems reasonable to suppose that there will be little encroachment upon existing agricultural or moor land, except around High Wycombe. The growth of Slough will largely be by the filling up of vacant frontages.

Open Spaces.—Inspection of the map accompanying the Greater London Plan discloses that the Green Belt and Outer Country ring are almost wholly preserved free from development, and that within them public open space is to be extended. All this militates against the probability of intensified gas demand evenly spread over the Uxbridge—Slough—Windsor—Ascot district. The plan dwells at length upon this prospect of open field and spaces right up to the built up area of London; if it is adopted it will be conclusive.

Finally, having taken into consideration all the foregoing, the figures in Table 1 were prepared to form a basis upon which to plan a grid system.

The Proposed Grid System

In planning the system of feeder mains recommended the following objects were borne in mind:—

(*a*) To provide a skeleton system of medium pressure mains that could be used for bulk supply between manufacturing stations, and for the filling of holder stations.

(*b*) To provide automatic control of the isolated holder stations to limit filling to off-peak times, to shut off the holder when full, and to feed back into the district mains from the holder when the district pressures fall.

(*c*) To provide governors to supply from the feeder mains into the local mains at key points and thereby enable the smaller holder stations, and the works at Marlow and Amersham to be shut down if desired.

The mains required are to be adequate for the next 30 or 40 years, and this, together with the large volume of gas to be moved, require for reasons of economy the use of pressures not exceeding 5.5 lb. per sq. in. in the initial stages. In 1949, the division had a population of about 320,000, with 94,000 consumers, and it was considered that the population would increase to 440,000, with 130,000 consumers, an increase of 38%. Allowance has also been made for doubling the average consumption per consumer so that the total consumption in the division would be 2¼ times the present consumption. Admittedly, this is guesswork, or intelligent anticipation, according to the generosity of the thoughts of critics, but is in accordance with the tendency of the times and can be proved right or wrong only in the event. By the same token the 1949 maximum day's consumption was estimated at 18 mill. cu.ft. and the total maximum quantity to be distributed in the future was taken as 50 mill. cu.ft. daily. In order to establish the cost per therm of the system, it was assumed that of this quantity only 2½ mill. cu.ft. daily would be manufactured locally at times of maximum demand. So that the Board should not suffer by failure to attain the anticipated demand, it was proposed to construct the bulk of the mains system in stages, so that parts of the scheme need not necessarily be implemented. Alternatively, should the consumption prove to be higher than the estimate the extra mains capacity could be attained by operating at higher pressures, which would continue to be economical because of the low initial pressures planned.

Proposed Feeder Mains.

The proposed routes of the feeder mains, are enumerated briefly below:—

(*a*) Slough to Windsor—12-in. dia. main, which will enable Windsor to be supplied in bulk from Slough, and the Windsor works to be shut down.

(*b*) High Wycombe to Marlow—12-in. dia. main, which

† Report of the Royal Commission on the Distribution of the Industrial Population (H.M.S.O.; Jan., 1940.)

has enabled the Marlow district to be supplied from High Wycombe, so that the standby plant at Marlow is no longer required.

(*c*) Bath Road, Colnbrook—12-in. dia. main, which affords an adequate supply to Colnbrook from the Slough area, and eventually should enable the 50,000 cu.ft. holder at Colnbrook to be put out of use.

(*d*) Installation of compressors at Uxbridge and conversion to medium pressure of the 16-in. dia. main from Uxbridge to Denham, and the 10-in. dia. main recently laid from Denham to Chalfont St. Giles. This affords an independent supply to Denham holder and an adequate supply to the Chalfonts.

(*e*) Provision of a separate 12-in. dia. inlet main to Denham holder from the main (*d*) above.

(*f*) A 24-in. dia. main along the Oxford road from Denham to Beaconsfield in extension of the 16-in. dia. main referred to in (*d*) above. This main will connect to the 12-in. and 14-in. dia. main from Beaconsfield to High Wycombe works, governors being installed to supply Beaconsfield, and the mains running southwards to Cookham. This main will give a limited bulk supply (60,000 cu.ft. per hr.) to High Wycombe from Uxbridge. A smaller main would have sufficed for present requirements, but a 24-in. dia. was recommended as conforming to the future bulk supply main *via* Western Avenue.

(*g*) The extension of of the 10-in. dia. main from Chalfont St. Giles to Little Chalfont, with a branch to Chorley Wood, and with governors at both points. This will ensure adequate supply to these areas and enable the Watford bulk supply to be reduced.

(*h*) Connection of the Dawley holder to the 12-in. dia. Southall—Uxbridge—Slough main by a new 12-in. dia. inlet main.

(*i*) The conversion to medium pressure and connection at Beaconsfield to the 24-in. dia. main referred to in (*f*) above of the 6-in. dia. mains to Amersham works, and from there to Missenden. This will enable both the Amersham and Missenden gasholders, of capacities of 142,000 cu.ft. and 295,000 cu.ft. respectively, to be supplied direct from the medium pressure system. Two villages are supplied from this main, and district governors will be necessary to supply these, together with some additional local mains. Missenden holder will be automatically controlled, but at Amersham there is attendance available.

(*j*) The extension of the 12-in. dia. main from Maidenhead, to provide a direct supply to Cookham holder, and to provide this holder with automatic controls.

On these projects so much progress has been made that (*b*), (*c*), (*d*), and (*e*) are completed; (*a*), (*f*), (*g*), and (*h*) are in hand for completion by autumn of 1951.

Proposed Bulk Supply Mains

Later are discussed the rival merits of local manufacture compared with bulk supplies from riverside gas-making stations, and the following bulk supply mains and extensions were planned in order that the capital cost should be estimated, and thus the economic annual charges that should be made to cover capital and maintenance:—

(1) (*a*) A 36-in. dia. main from Fulham to Richmond, crossing the River Thames by attachment to Putney Railway Bridge. The length and estimated cost are:—

Fulham to Richmond,
10,560 yd. of 36-in. dia. main. £250,000.

(*b*) Extension of the 36-in. dia. main now laid from Richmond to Twickenham in the Chertsey arterial road, along that road to Feltham Hill, and thence to Staines. At the crossing of the Great South West Road at Staines a connection would be made with the 18-in. dia. Southall—Staines main, while the 36-in. dia. main would be reduced to 30 in. dia. and continued to Slough. The lengths and estimated costs of this important project are:—

Twickenham to Staines,
13,200 yd. of 36-in. dia. main.
Staines to Slough,
15,000 yd. of 30-in. dia. main. } £530,000.

When completed from Fulham to Slough this main will have a capacity of 20 mill. cu.ft. per day to Slough, in addition to supplies *en route*.

(2) Supplying all the districts of Uxbridge near Southall from (*a*) the Southall—Uxbridge—Slough 12-in. dia. intermediate pressure main, and (*b*) the Southall—Hayes Bridge 12-in. dia. intermediate pressure main. To take full advantage of the latter the 8-in. dia. outlet main from the existing governor at Hayes Bridge will be reinforced by a 14-in. dia. main, so that a larger bulk supply may be provided at this point. It is estimated that the total supply from Southall could be increased to 4.8 mill. cu.ft. per day by these alterations.

(3) Laying a 30-in. dia. main westwards along Western Avenue from the 30-in. (part 24-in.) dia. Southall—Harrow main to the end of the Western Avenue at Denham, there connecting to the 16-in. dia. main from Uxbridge and the 24-in. dia. main to Beaconsfield. At a later stage an 18-in. dia. main to be laid from Beaconsfield to High Wycombe to afford a complete bulk supply to the latter works. This main, operating at pressures (90 in. W.G.) now available at Southall, would have a capacity of 4.8 mill. cu.ft. per day into Beaconsfield, and 2.4 mill. cu.ft. per day to High Wycombe. By installing plant at Southall capable of pumping to 150 in. W.G. presure, 13.7 mill. cu.ft. per day could be delivered into the Uxbridge districts, of which 6 mill. cu.ft. per day would be delivered at High Wycombe.

The total length of the 30-in. dia. main would be 13,000 yd., and the estimated cost	£202,000
The length of the 18-in. dia. section to High Wycombe would be 10,500 yd. and the estimated cost	£73,000
Total	£275,000

(4) The laying of a 24-in. dia. main as an extension of the 18-in. dia. main from Staines works, which now terminates at Egham Hill, to connect Ascot works to the Southall—Staines trunk mains system, at an estimated cost of £95,000. With the new pumping plant now on order for Staines works, this main could supply 4 mill. cu.ft. per day to Ascot district, but this quantity could be increased to 9 mill. cu.ft. per day when necessary by installing large pumps at Staines. The recently authorised 18-in. dia. main from Ascot to Bracknell would form an extension of this main and provide an adequate supply for the new satellite town at Bracknell.

Of the above schemes (1) (*a*) and (*b*), and (2) are in hand, but schemes (3) and (4) will be postponed for a few years until they are required to meet increased demands at Uxbridge and Ascot, respectively.

The total estimated cost of all the proposed mains scheduled is £1,160,500, and it will be seen there is no intention of making a ring main at the periphery of the area. Such a ring main would run through thinly populated parts, and the cost could be regarded only as an insurance premium not worth paying.

Capacity of the 'Gas Light' Grid

It was necessary to ascertain to what extent the 'Gas Light' grid would be affected by passing from east to west such a quantity of gas as 47½ mill. cu.ft. daily, in addition to the existing quantity, and making due allowance for the future. In regard to the pumping mains system from Beckton to Southall, westwards from Westminster there is but one 36-in. dia. main to Fulham, one 36-in. dia. main from Fulham to Kensal Green, and a 36-in. (part 30-in.) dia. main from the latter to Southall. There is also a 42-in.—36-in.—24-in. dia. northern link to Kensal Green, with stage pumping at Swiss Cottage. The full available pumping pressure at Beckton is 150 in. W.G., but the maximum used in recent years is only 70 in. W.G. On a winter day the average rate of pumping westwards is estimated as 3 mill. cu.ft. hourly. It should be realised that this mains system does not have to cope with peak-hour demands, and this was exemplified on a Sunday morning last winter when, for volumetric test purposes, all pumping westwards from Beckton was stopped between 11.30 hr. and 13.00 hr. On a test it was found possible to transmit 1¾ mill. cu.ft. hourly, with an average initial pressure of 57 in. W.G., and a final pressure at Fulham of 30 in. W.G. As may be expected, the pressure loss on the single 36-in. dia. main from Westminster to Fulham was severe, being 11 in. out of the total loss of 27 in. W.G. To obviate the bottle-neck it was decided to convert to intermediate pressure two existing 36-in. dia. low pressure mains; one runs from Westminster to near Hyde Park Corner, and the other from Fulham to Hyde Park. These could easily be connected together and isolated, and the work is now in hand. This conversion nearly doubles the capacity of the Westminster to Fulham system, and has the advantage that much of the gas now supplied from Fulham district mains will be supplied from Beckton, *en route*. It is estimated that on completion of the work it will be possible to pump 80 mill. cu.ft. daily into Fulham for transmission westwards. At Fulham, gas for Southall must be re-pumped as at present, but for several years it is anticipated that on the Slough main no pumping stage will be required after Fulham. The 36-in. dia. section of the main runs to Staines, and allowance has been made for this main to supply the whole of the gas now delivered by Southall in a southerly direction. Hence, without increasing the capacity of the Fulham—Southall system, all the gas needed along the Southall—High Wycombe main will be available at Southall.

Sizes of Pipes and Costs of Mainlaying

The two 48-in. dia. mains from Beckton to London were laid in the years 1870 and 1871, and operated at holder pressure. For 80 years, as more and more gas needed to be carried from Beckton, the initial pressures have been increased, and now usually attain about 60 in. W.G. It has been shown that the system will be adequte for very many years to come with pressures not above 150 in. W.G. Surely, this must be a supreme example of the wisdom of providing adequate pipes, for not only would today's cost be fantastically high (about £3 mill.), but it would be physically impossible to take a reasonably direct route. Probably the shortest feasible route would measure 50% more, so that still higher pressures, or larger pipes, or both, would be required, and the cost might be nearly £5 mill.

Local Manufacture Compared With Bulk Supplies

Of the 50 mill. cu.ft. of gas eventually required on a maximum day in the South Western division, 38.5 mill. cu.ft. would go to the area north of the River Thames with Windsor, and 9 mill. cu.ft. to the Ascot area. Chertsey does not need consideration, because it is already supplied from the grid in bulk. The local manufacturing stations that might in future supply all or part of the 38.5 mill. cu.ft. are those at Uxbridge, Slough, High Wycombe, Windsor, and Maidenhead.

Uxbridge suffers from bad facilities for coal transport; it has no railway siding, but has a wharf, with handling plant, on the Grand Union Canal. In former years coal was delivered by barge from Brentford staithes, but lately the high cost of canal transit has caused a diversian to road haulage. The net cost of coal at Uxbridge is 2.190d. per therm greater than at Beckton. Great improvements have been made to the plant, and there is plenty of scheduled land, but it is not considered wise further to enlarge the station.

Slough station has good railway facilities, but the comparable net coal cost figure is +3.050d. The site is restricted, and a great increase in capacity could be accomplished only by drastic reorganisation of plant lay-out.

High Wycombe has no railway siding and the site is fully developed. The comparative net coal cost is +3.471d., and it is impossible to contemplate further installations.

Windsor is a town that would be marred by a large industrial building, and in fact there is a building height restriction in force that would limit the choice of plant. The gasworks is in a built-up neighbourhood, and near the River Thames. For these and for reasons of cost it is expected to cease manufacture as soon as a bulk supply main is completed.

Maidenhead gasworks are in Taplow, on the left bank of the River Thames, in rural surroundings, and the site is unsuitable for development. Only carburetted water gas is now made, and that for meeting peak load demands.

Economics of Bulk Supply

Having seen that extensions at the stations presently working are either impossible, or fraught with difficulty and certain to be relatively uneconomical, it is necessary to ascertain the cost of a bulk supply; and to assume the gas required to be made at Beckton. Comparative figures of gas production costs, together with capital costs of the necessary trunk mains, pumping costs, and a figure for the coke equivalent are given in Appendix 1.

Study of the figures shows that the average cost of production in the divisional works is to the cost of gas and coke delivered from Beckton as 150 is to 115. These figures are arrived at by assuming the full future supply of 38.5 mill. cu.ft. daily, and the absence of a mains charge east of Fulham. Until the full quantity is reached the cost of bulk gas must necessarily be higher, but even if the mains charge be doubled the bulk supply remains cheaper; and, as already stated, the scheme is to be carried out in parts as needed, so that the mains charge may be kept in conformity with increasing demand. As far as a charge for the Beckton—Fulham mains is concerned, none can be made, as these mains have been fully depreciated, and the Westminster—Fulham conversion is needed for other and much greater usage.

Ascot District

Ascot is completely isolated from any other part of the area of the North Thames Gas Board, so that a link with the nearest point of the grid, at Egham, would serve only one purpose. The Ascot gasworks at Sunninghill is thoroughly up to date, has railway sidings, and should be able to meet the demand of the district for some years to come, provided there is no substantial progress on the Bracknell satellite town. Completion of the new town scheme would increase the load by 40%, which would outstrip local capacity. There is available land for works additions at Ascot, so that whether or not bulk gas supply should be provided is purely one of cost. The net cost of coal is 3.326d. per therm in excess of that at Beckton.

It is difficult to foresee the exact nature and scope of development around Ascot, so that a main of somewhat larger capacity than is now strictly necessary has been planned: Nevertheless, after making all allowances as heretofore, it is possible to supply bulk gas 1½d. per therm cheaper than when locally made.

The proposals outlined for distribution in the western part of the North Thames Gas Board's area embrace the provision of a medium pressure grid system of comparatively large diameter mains supplying gas to storage stations and directly

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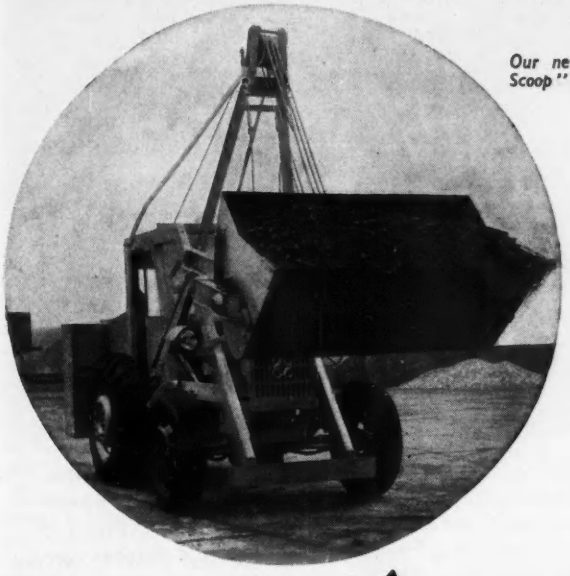

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∴ Hourly saving = 3/0d. **£150**

MAINTENANCE★ Assuming maintenance of new 1 cu. yd. machine to be no more than £50 per annum and that of an 8, 10 or even 15 year old machine to be at least £100 per annum, the saving in maintenance on a new machine for the first year. = ... **£150**

£974

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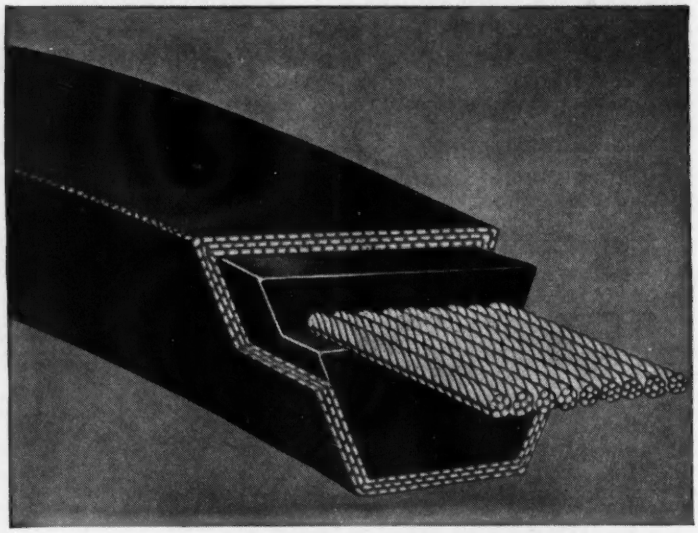

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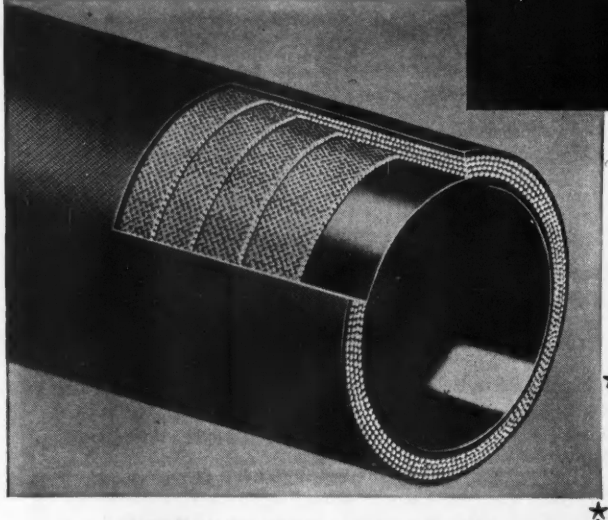

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to the low pressure mains through district governors; few consumers will be supplied directly from the grid system through service regulators. It is interesting to compare this system with that obtaining in South Essex, at the other end of the Board's area of supply, where the majority of consumers are supplied through services connected to the high pressure mains. The South Essex system has been fully described in a paper presented to the 85th Annual General Meeting of the Institution of Gas Engineers.* Both areas are largely rural, and it would seem desirable briefly to indicate the conditions that have caused dissimilar distribution treatment. The western rural area contains eight towns, each with expanding demands, and at vesting day there existed low pressure mains fairly covering the consuming areas, so that there was no substantial number of high pressure services. Moreover, development of gas sales had long passed the stage of but few consumers per mile of main, which is one of the major conditions favouring small mains and high pressures.

The South Essex scheme was inaugurated in 1913, when there was a sparse population, most of which lived in a number of villages, there being no towns comparable with Uxbridge, Wycombe, or Windsor. High pressure distribution was the only possible means of giving an economic gas supply also bearing in mind that the standard of average income was rather low.

During the past 30 years the inhabitants have greatly increased in number, and the high pressure system has hitherto been expanded to meet requirements. The increased cost of power for pumping, and the present stage of development, makes its perpetuation no longer advisable, so that a policy has been introduced to sectionalise the high pressure system into several groups, each supplied at a lower pressure by local pumping plants situated at holder stations, which will be supplied from the medium pressure system.

The new town of Basildon, which is being built almost in the middle of South Essex, will ultimately be wholly a low pressure area.

DISCUSSION

Mr. J. H. Dyde (President-Elect) said that the Uxbridge area was extensive. From 1906 until 1936 the Uxbridge Company absorbed many small rural undertakings and included two important towns, Maidenhead and High Wycombe. Then in 1936 they were themselves gobbled up by the South Eastern Gas Corporation, but up to 1936 there had been no serious attempt at all to co-ordinate supplies over this area of something like 234 square miles. It was served at low pressure with relatively small diameter mains which, as building development advanced, stretched out still further until they reached the fringes of the adjoining undertakings which had been acquired. At strategic intervals gasholders were built and were left to float on the mains. The idea was that they would fill up at night and during periods of off-consumption and then feed back into the general distribution system at periods of high consumption. The other important point was that the small works were left after acquisition to think about their useful life, and it was hoped that by the time they had come to some conclusion this tenuous linking would be sufficient to keep the whole system going.

That was the distribution system that confronted him in 1942, and his first impulse was to be critical. He thought it comic, which perhaps explained the author's final paragraph in which he said that he hoped that his paper would be found to contain a little entertainment value. But, on further reflection, there was always a reason for a policy. He tried to find the reasons for the situation. The first reason was that, having paid a pretty high market price for these small undertakings, they had not got any further capital to expend, and it was a costly business to have to lay sizeable transmission mains to connect small loads over widely dispersed points.

The second thing was that rural areas at that time did not appear to afford a high prospect for demand. In the pre-war period most undertakings were worried by falling consumption per consumer. The high demand which they were getting now was due not to any promotional sales policy but to shortage of solid fuel and full employment.

Ribbon development was prevalent and the new mains followed in its track.

During the five years of the war they had an increase in output of 100% occasioned by the reception of evacuees and the setting-up of war factories and so on. It was, of course, that enormous increase which revealed the weakness of the system—namely, its lack of flexibility.

President-Elect Makes a Comparison

'I want,' said Mr. Dyde, 'to make a comparison for a few minutes. It is important to do so from the point of view of nationalisation to see the difference in outlook between a holding company and what has happened now under the spacious planning of an area board organisation. The South Eastern Gas Corporation plans provided for a trunk mains system, the greater part of which was to operate at medium pressures—2 lb. to 5 lb.—linking the three manufacturing stations at Uxbridge, Slough, and High Wycombe and taking in en route the key holders at Denham and Cookham. Both the South Eastern and the Eastern Gas Board schemes planned for the release of gas at suitable points into the existing low pressure mains to reinforce supplies and balance pressures to make really effective the vast amount of small diameter main laying that had gone on. Both plans envisaged the shutting down of manufacture at Amersham, Marlow, and Maidenhead. The main difference in the cost of manufacture between the riverside stations and the outside stations is the result of the ultimate source from which the gas has to be supplied. Looking at it from the point of view of a company before vesting day, new carbonisation planned at High Wycombe in 1944 gave the former Company an opportunity to overcome the difficulty about increasing their bulk supply, and further extensions were made at Uxbridge which have subsequently been completed since the vesting date. During the war the Slough works were completely rebuilt. It was thought that because of its strategic position on a rail head and so on it could be doubled in capacity without any serious technical difficulty.

'The difference is immediately apparent. Under the holding scheme the whole of the area in 30 years' time is to be supplied by gas. Therefore there is a difference in the diameter of the mains between the original scheme and the new one. For instance, the main spine of the system which runs from Southall through Uxbridge to High Wycombe between Denham and Beaconsfield under the proposed scheme is to be brought up to 24 in. where previously it was 14 in. Other differences relate to the very large, 30 in., mains from Western Avenue nearly to Uxbridge and the 30 in. main from Richmond into Slough to give complete cessation of manufacture at the local stations. It is a wonderful example of long-term planning.'

Lack of Planning

Lieut.-Col. J. A. Gould, M.C. (South Eastern), remarked that his experience showed that in many cases there seemed to have been little or no planning and, unfortunately, the cost of correcting the position had progressively increased with the increased cost of providing new mains and other plant. The greater his experience of distribution had become the more he had realised the lamentable lack of importance attached to and lack of consideration that had often been shown in the past to distribution problems in spite of the proportion of a gas undertaking's capital that distribution plant represented. Even where, presumably, care was taken in planning, the author drew attention to a case where an 8 in. trunk main laid in 1931 was found too small directly it was completed and was augmented by a 12 in. main in 1935 and an 18 in. main in 1946.

He was interested in the author's remarks regarding holders floating on the mains to assist the supply where distributing systems were over-taxed. It was not clear how far Uxbridge showroom was from the gasworks. Why was the pressure registered at the showroom only 3 in. at 12 noon when the pressure farther out on the district at Oaks Road was only 1¼ in.? Did this suggest that there was such a draught on the main at peak load that, although there was provision at the works for maintaining an outlet pressure of 10½ in. during the early hours of the morning—to keep the outlying holder afloat—the pressure dropped to 3 in.? Alternatively, was there no booster at the works, the 10½ in. being maintained by holder pressure which dropped due to the works holder being nearly emptied during the peak load?

* Escreet, H. J. A Survey of Gas Distribution Practice. Inst. Gas Eng. Comm. No. 337.

HORIZONTAL RETORTS—(concluded from p. 812)

of minute cracks. 'To cold patch and fill up those expansion allowances,' continued Mr. Dougill, 'must inevitably develop some distortion and over-stress on re-heating. Our general practice is to aim at a general life of retorts of about eight years. For the first five years they usually work continuously, and after that they have a cooling down period, usually each summer, according to the demand for gas. During that period the only patching necessary is done while the retort is at full working temperature. The amount of such patching is practically negligible for the first five years, and does not become in any way appreciable until the sixth or seventh year, and even then it is not of unmanageable proportions. By this means we get a setting which has a very cheap maintenance from the point of view of refractory repairs, and at that stage we re-set so that we get a shorter life but an infinitely lower cost in repairs.'

'Similarly,' he went on, 'I cannot understand the authors' objection to arches. If due allowance is made that where arching, as in the main setting arch, has its haunches fixed, you must of course allow for the rise on that arch on heating. On the other hand, as in the combustion arch, where the whole arch goes up at one temperature, the expansion of the arch, both horizontally and vertically, is simply that of solid brickwork with a hole in it, and frankly we do not find any difficulty with arches where due allowance is made for that in the design. We support the authors in the use of air-cooled settings.'

Mr. John Foxton (Cheltenham): The industry expects to receive a lead from organisations such as the late South Metropolitan Gas Company, who decided that, in order to obtain higher efficiencies, coke ovens and mechanical producers were advisable. It is unfortunate that the authors have not given costs of fuel to producers. With built-in producers, run-of-the-retort-house coke, including breeze, etc., is charged to the fires, so that the proportions of sizes of coke for sale is unaffected. The fuel for external producers was inferior, composed of scalpings, containing most of the breeze of run-of-retort-house coke. This resulted in a coke for sale of high quality, containing very little breeze, except that produced by cutting. Now the mechanical producer presents quite a different picture, since in order to produce the fuel equivalent to 11% of the coal carbonised, at least 15% of the capacity of the grading plant is required to produce the 2 in. to 1 in. size coke. It follows that with a large domestic demand, most of the coke will have to be cut to supplement that used on the producers. This will produce more breeze, and the net result is that the total breeze production is greatly in excess of that produced normally.

Mr. K. Francombe (Whessoe Limited) commented that there were two or three coke oven installations in this country where electro-static precipitates were being successfully employed in connection with the Dougill vaporiser to clean producer gas. But, supposing the breeze content were materially increased, a stage might rapidly be reached when the proportion of dust to tar in the producer-gas was such that the gas would, in electrostatic precipitates, become virtually uncleanable. He thought that experiments should be carried out with existing mechanical producers gasifying higher and higher proportions of breeze to see if this gas can be cleaned before any big installation where the whole of the producer gas in a modern coke oven setting was produced from breeze, because difficulties might be experienced which would have a serious effect on the gas-making capacity and on the generator brickwork of the coke oven battery.

Personal

Mr. Thomas Gourlay, a native of Greenock, has retired after 39 years as Works Manager to the Kirkwall undertaking. He is succeeded by **Mr. Derek Lord,** who is appointed Group Manager of Orkney and Shetland under the Scottish Gas Board.

◇ ◇ ◇

Mr. W. H. Johnstone, Scottish Representative, Parkinson & Cowan (Gas Meters), Ltd., defeated Donald Peers in the second round of the British Amateur Golf Championship at Porthcawl, 8—6. In the third round Mr. Johnstone was drawn to play the Scottish International, Mackie (Gullane) and was dormie 4. He was, however, defeated at the 19th.

◇ ◇ ◇

Dr. S. W. Fisher, B.A., M.D., who, until his retirement at the end of last year was Principal Medical Inspector of Mines, Ministry of Fuel and Power, has been appointed as consultant to the National Coal Board. He is a member of the Miners' Welfare Commission and has taken an important part in the international study of industrial medicine as a representative at international congresses and as a member of the Permanent International Commission of Industrial Medicine.

◇ ◇ ◇

Mr. William Scott, Assistant Manager at Hamilton since 1934, has been appointed by the Scottish Gas Board as District Engineer for the Hamilton district of the Lanarkshire group, in succession to Mr. J. B. Ferns, who died last December. Mr. Scott went into the laboratory of an Edinburgh public analyst on leaving school and qualified as an analytical chemist at Heriot Watt College in 1921. He then went to the Alloa Corporation Gas Department as chemist, being appointed Assistant Manager in 1926. After four years he became Manager of the Tillicoultry Gas Company, holding that position until he went to Hamilton.

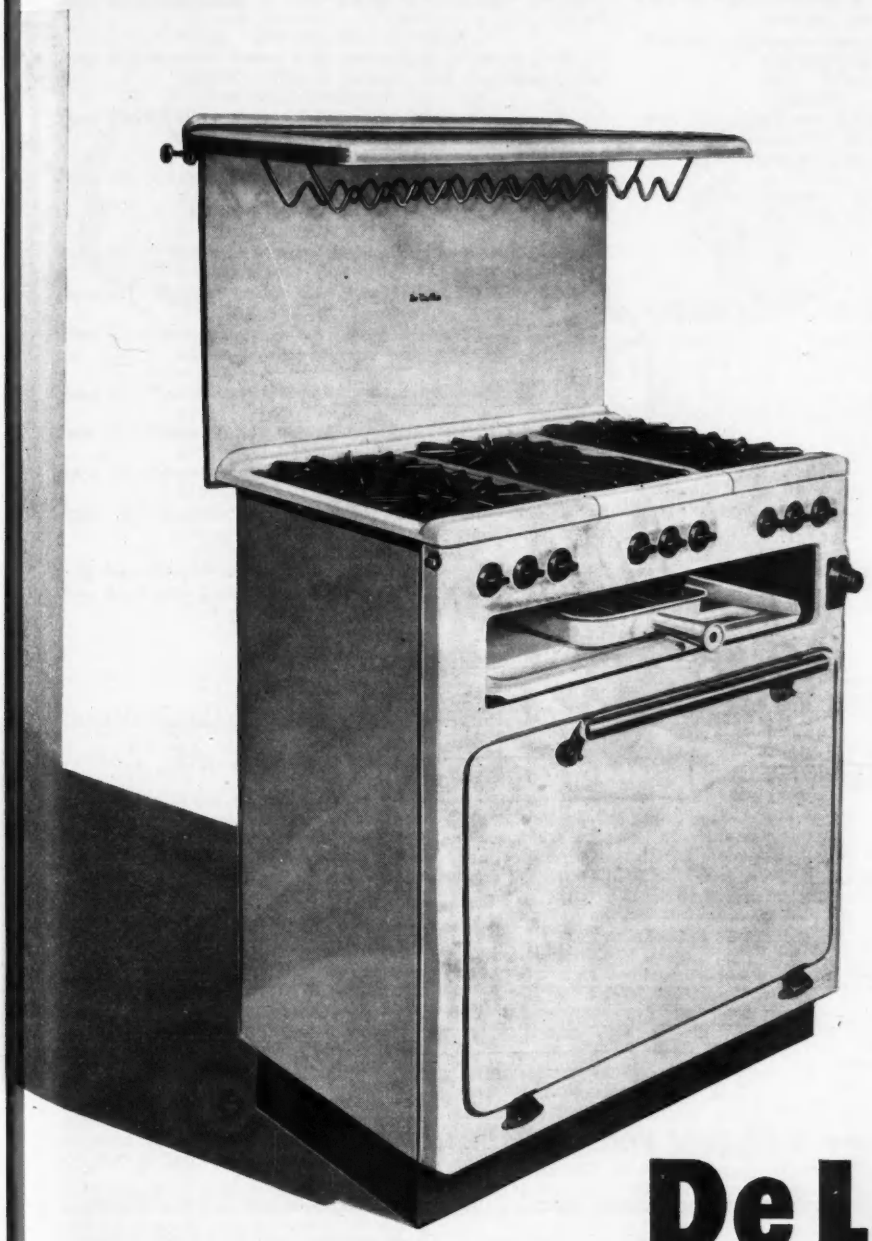
◇ ◇ ◇

Mr. Henry Richards, whose retirement from the position of Unit Controller at Redruth was announced in the *Journal* of May 23, received a presentation on June 1. His colleagues at Redruth and Camborne made him the gift of a wireless set in recognition of his 45½ years' service to the gas industry. Mr. L. J. Bowles, who presided, has in hand the preparation of an illuminated address containing the names of the subscribers, which will later be handed to Mr. Richards. The presentation of the wireless set was made by Mr. G. A. Lanyon, a Director of the former Redruth Gas Company, and now a member of the Redruth unit staff of the South Western Gas Board.

BIRTHDAY HONOURS

The Birthday Honours announced last Thursday included the conferment of the C.B.E. on Mr. Edward Crowther, M.ENG., M.I.C.E., Chairman of the Northern Gas Board. Dr. Harold Hollings, D.SC., F.R.I.C., Controller of Research, North Thames Gas Board, received the O.B.E., and the distinction of M.B.E. was conferred on Dr. H. A. Fells, PH.D., F.R.I.C., Industrial Fuel Consultant; Dr. Arthur Marsden, PH.D., M.SC., F.R.I.C., Area Scientist, South Western Gas Board; Mr. John Powdrill, General Manager and Engineer, Pontypool, Wales Gas Board; and Mr. Archibald Wylie, Sales and Service Manager, East Midlands Gas Board. Also of interest to the gas industry were the Knighthood conferred on Mr. Roger Duncalfe, Chairman of the British Standards Institution, and the O.B.E. received by Dr. J. W. T. Walsh, Senior Principal Scientific Officer of the D.S.I.R.

The British Empire Medal was awarded to Christopher S. Aveson (Assistant Foreman, Southern Gas Board, Southampton); Albert A. Bates (Warehouse Checker, North Thames Gas Board); Harry Boyd (Trench Inspector, East Midlands Gas Board, Sheffield); Isaac W. E. Hill (Truck Weighman, North Eastern Gas Board, Leeds); Jonathan Hodgson (Distribution Foreman, Northern Gas Board, Workington); Thomas Reynolds (Storekeeper, Granton, Scottish Gas Board); and Robert P. Robertson (Manager, Machynlleth undertaking, Wales Gas Board; and Frank J. Walker (Mains Foreman, Camberwell, South Eastern Gas Board).



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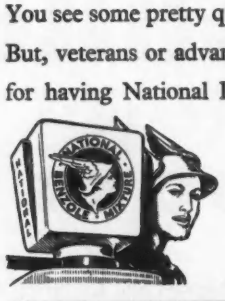

NATIONAL BENZOLE MIXTURE

29C

Diary

June 15.—Institution of Gas Engineers (Midland Section): Summer Meeting and Chairman's Day, Oxford. Works visits and tour of colleges.

June 16.—Scottish Junior Gas Association (Western District): Visit to works of General Gas Appliances, Ltd., Audenshaw, Manchester.

June 18-29.—Fifty Years of Industrial Standardisation Exhibition, Science Museum, South Kensington. Gas Council exhibit.

June 20.—Eastern Junior Gas Association: Annual General Meeting, Globe Hotel, King's Lynn. 11.15 a.m. Afternoon coach tour to Sandringham Gardens and Hunstanton.

June 23.—Wales and Monmouthshire Junior Gas Association: Ladies' Day.

June 23.—Western Junior Gas Association: Summer Meeting and Ladies' Day, Torquay.

June 23.—Manchester District Junior Association of Gas Engineers: Ladies' Day, Chester, and visit to Chester works.

June 25.—North Eastern Gas Consultative Council: Leeds, 2.45 p.m.

June 28.—North Thames Gas Consultative Council: Westminster City Hall, Charing Cross Road, 2.30 p.m.

June 29.—Northern Junior Gas Association: Annual General Meeting.

June 30.—London and Southern Junior Gas Association: Ladies' Day and Summer Outing, Windsor, Cookham, and Marlow.

July 3-6.—Royal Show, Cambridge. Gas Council exhibit.

July 3.—South Eastern Gas Consultative Council: Quarterly Meeting, Goring Hotel, Victoria, 2.15 p.m.

July 4.—Institution of Gas Engineers (London and Southern Section): Summer Meeting, Watford, 10.30 a.m.

July 10.—Women's Gas Federation: Festival Fare Cookery Competition Finals, Park Lane Hotel, London, W.1. Presentation of Prizes by H.R.H. Princess Elizabeth.

July 11.—Gas Council Commercial Managers' Committee, Gas Industry House. 10.15 a.m.

July 27.—Northern Junior Gas Association : Address by A. Pillans, Works Manager, By-Product Works, Northern Gas Board, followed by a visit to St. Anthony's By-Product Works, Northern Gas Board, Newcastle.

CHARTERED INSTITUTE OF SECRETARIES

The Chartered Institute of Secretaries is celebrating its Diamond Jubilee in London this week. Today (Wednesday), after a special Service in St. Paul's Cathedral, at which the Dean will preach, members and guests will be received by the President (Sir Edward Wilshaw) in the Drapers' Hall and by the Vice-President (Mr. J. R. W. Alexander) in the Armourers' and Brassiers' Hall. Following the ball in the Guildhall tomorrow and the dinner at the Dorchester Hotel on Friday, a Masque in the Elizabethan tradition, written and produced for the occasion by Mr. L. Du Garde Peach, will be presented.

Mr. J. R. W. Alexander's offices are now at 2, Victoria Street, London, S.W.1. Telephone Number: Abbey 2008. His other addresses remain unaltered.

South Eastern Gas Prices Up Again

Heavy increases in the costs of coal, freight, gas oil, and materials and higher rates of wages have made it necessary for the South Eastern Gas Board again to raise the price of gas. New charges which have been approved by the South Eastern Gas Consultative Council will be brought into force on July 2.

The Council was informed at its meeting on April 3 that after allowing for increased revenue from by-products the increased costs amounted to £1,581,000 per annum. It is expected that as much as £1 mill. per annum will be met out of the revenue from the increasing sale of gas and by means of economies and more efficient working. The balance of between £500,000 and £600,000 has to be met by higher gas prices.

A review of present prices in the area has led to the conclusion that many of the reasons for past differences in prices between similar districts no longer apply. The alterations which are now being made in the price of gas bring into force a single flat rate charge in the main part of South London with a slightly higher charge in outer districts. On the same principle the former differences in charges in Kent and Sussex will be substantially reduced.

The increases in flat rate prices vary from 0.15d. to 2.5d. per therm. Some prices remain unaltered and a few which were above the average level will be reduced.

Instrument Maintenance Mechanics

The City and Guilds of London Institute announces the adoption of an important new scheme of courses and examinations in instrument maintenance, which has been drawn up by an authoritative advisory committee, including representatives of industry, the Society of Instrument Technology, the Ministries of Supply, Fuel and Power, and Education, the Service Departments, major engineering professional institutions, and associations concerned with technical education.

The scheme is intended to meet the needs of mechanics and technicians concerned in the maintenance, repair, and installation of the instruments used for process and production control in industrial plants and in H.M. Forces. Particular attention is given to the requirements of the chemical, iron and steel, and petroleum industries, to fuel economy, and the needs of the Services, but the structure of the scheme is such that it will be found to have wide application.

A pamphlet containing the regulations and syllabuses for the City and Guilds examinations will be available shortly, price 6d., from the City and Guilds of London Institute, Department of Technology, 31, Brechin Place, London, S.W.7. Further information about the scheme may be obtained from the same address.

Proposed Price Rise in Dublin

An application to be permitted to charge 2d. per therm more for gas has been made to the Prices Advisory Body of the Republic of Ireland on behalf of the Alliance and Dublin Consumers' Gas Company. Mr. W. J. Robertson, General Manager of the Company, said that it was estimated that the maximum cost of the increase would be 4d. a week for an average family. The increase was necessitated by higher wages, higher costs of coal and oil, and increased prices of sundry materials.

Since 1947, the Company had made successive decreases in the price of gas, and a substantial reduction in the price of coke. The company felt that the whole of the increased costs should not be passed to the price of gas, but that coke products should bear their proper share of the increased cost of coal. The Company also wished to restore its pre-war rate of dividend of 8% from the present 6%.

Mrs. A. D. Skeffington, opposing for the Irish Housewives' Association, said that since 1939 gas prices had increased from 10.2d. per therm to 1s. 8d. They opposed any increase in dividend.

The Prices Advisory Body will make its recommendations in due course.

Presentation of Prizes to local winners in stage 1 of the 'Festival Fare' national cookery contest was made by Mrs. A. Perkins at the showrooms of the Winchester gas undertaking on May 30.

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CASES FOR BINDING
Quarterly Volumes of the "Gas Journal."
5/- each, post free
Walter King, Ltd., 11, Bolt Court, Fleet Street, London, E.C.4.

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when patched with–
ONX SUPER 83 BRAND FIRE CEMENT
A recent testimonial from Gas Dept.
"We are pleased with results obtained after using ONX Super '83' Brand. "Our settings were very bad, with large cracks in retorts, and portions of wall actually collapsed.
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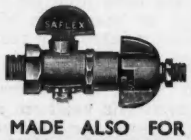

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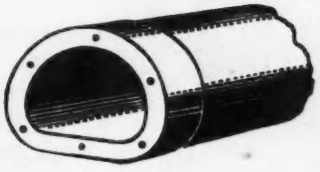

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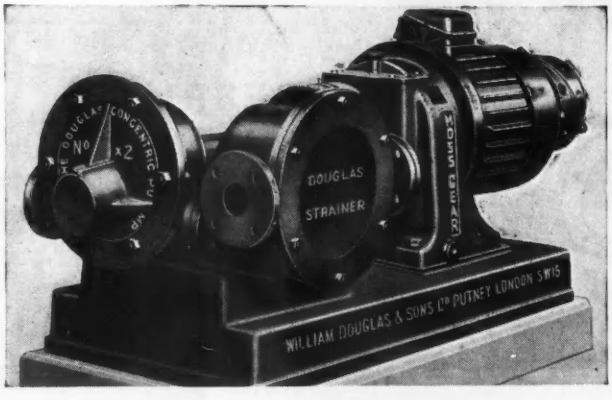

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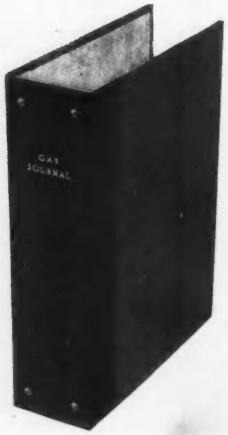

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Subscription Rates: Home and Empire :- 52/- per annum ; Foreign :- 60/- per annum. (Both payable in advance.) A copy of the "Gas Journal" Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at 1/9 per line (approx. 7 words) - minimum charge 10/6. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10" deep x 7" wide; block screen 120.

BUSINESS MANAGER: S. T. CULLEN

MIDLANDS OFFICE: 10, Union Street, Birmingham.

NORTHERN MANAGER: W. Q. Foster, 33, St. Helens Road, Harrogate. 'Phone: Harrogate 84291.

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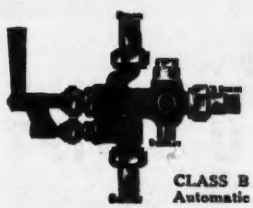

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APPOINTMENTS VACANT

A DRAUGHTSMAN aged 25 to 30 is required for the Clarence By-Product and Distillation Plant of Messrs. Dorman Long & Co. Limited. Applicant should be good, all-round man, preferably with experience of the above type of plant. Permanent employment with good prospects to competent man with initiative. Pension scheme in operation. Apply stating age, salary required, when at liberty, and giving full particulars of technical education and experience to: Chief Technical Engineer, Dorman Long & Co. Limited, Central Engineering Department, Royal Exchange, Middlesbrough.

NORTH THAMES GAS BOARD

A SENIOR DRAUGHTSMAN is required in the Chief Engineer's Department at Westminster.

Applications are invited from candidates, not less than thirty years of age, who are experienced in the design, layout and detailing of mechanical handling plant. The starting salary would be in the region of £650 per annum.

The appointment is of a permanent nature, and pension arrangements will be discussed with short list candidates.

Applications, stating age and full particulars of training and experience, should be sent to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, London, W.8, quoting reference number 10,000.

EASTERN GAS BOARD

(CAMBRIDGE DIVISION)

PETERBOROUGH GROUP.

ASSISTANT TO GROUP ACCOUNTANT.

A suitably qualified Accountant, 30 to 40 years of age, is required to assist the Group Accountant in the control of the financial and costing activities of six Gas Undertakings attached to the Peterborough Group.

Applicants should hold, or have held, one or more executive accounting appointments and should be conversant with modern financial and cost accounting methods and records.

Experience in the Gas Industry is desirable.

The salary will be in accordance with Grade IX of the National Joint Council for Gas Staffs Salary Scales and the commencing salary within this grade is dependent on the experience of the person appointed.

Applications, stating age, and giving full particulars of qualifications and experience, together with the names of two referees, should be sent to the General Manager, Eastern Gas Board (Cambridge Division), 52, Sidney Street, Cambridge, within fourteen days of the publication of this advertisement.

SOUTH WESTERN GAS BOARD

MACHINE ACCOUNTANT.

APPLICATIONS are invited for the appointment of a MACHINE ACCOUNTANT tenable in the Chief Accountant's Department in Bath in the first instance. The main duties attaching to the appointment will be connected with the installation and operation of "Powers" forty column punched card equipment as applied to the Board's financial and costing functions and it is essential, therefore, that candidates should have a wide experience of punched card accounting in one or more of the Public Utility industries, preferably including the Gas Industry. Possession of a recognised accountancy qualification, though not essential, would be an advantage.

The salary for the appointment will be in the range from £800 to £1,000 per annum, and the commencing salary will be determined in accordance with the qualifications and experience of the person appointed.

The successful candidate will be required to pass a medical examination and the appointment will be subject to the provisions of such superannuation scheme as may be adopted by the Board.

Applications, stating age, qualifications, experience, present appointment and salary, together with the names of two referees, should be sent to the undersigned to be received not later than Wednesday, June 20, 1951.

W. N. CURTIS,
Secretary and Solicitor.

9a, Quiet Street,
Bath.
May 30, 1951.

SOUTH WESTERN GAS BOARD

CHELTENHAM SUB-DIVISION.

STROUD UNIT.

VACANCY FOR CARBONIZING FOREMAN.

APPLICATIONS are invited for the position of CARBONIZING FOREMAN at the Gas Works of the Stroud Unit, Canal Side, Stroud, Glos.

The person appointed must be experienced in the control of retort house labour, fully conversant with Horizontal Retort House practice, and a strict disciplinarian.

The successful candidate will be responsible to the Station Engineer for the control and efficient working of the Horizontal Carbonizing plant.

The carbonizing plant at Stroud consists of nine beds of eight through retorts, with Drakes charging and discharging machine with producer gas dilution plant.

The salary offered will be within the grade VI B (£400-£445) of the Intermediate Grades of the National Joint Standing Committee.

A house is available at a reasonable rent.

Applications addressed to the undersigned should be received not later than fourteen days after the appearance of this advertisement.

A. L. MORRIS,
Sub-Divisional Manager.

Cheltenham Sub-Division,
North Street,
Cheltenham, Glos.

(*Classified advertisements continued on Supplement 4*)

APPOINTMENTS VACANT (ctd.)

JUNIOR DRAUGHTSMAN required, preferably experienced in Gas and Chemical Engineering, A.E.S.D. rates paid. W. C. Holmes & Co. Ltd., 119, Victoria Street, Westminster, S.W.1.

HUMPHREYS & GLASGOW LTD., require OPERATING ENGINEER age 21-30. Salary according to experience. Good prospects. Pension scheme. Reply to 22, Carlisle Place, London, S.W.1.

FIRST CLASS GAS FITTERS required for Railway Executive Crewe Gas Undertaking. Preference will be given to applicants with good all-round experience. Wages in accordance with Railway Shopmen's National Council Rates, *i.e.*, £6 3s. 0d. per week of 44 hours. Applications, with two references, to Works Manager, British Railways, Chester Bridge, Crewe.

SOUTH EASTERN GAS BOARD

WEST SURREY DIVISION.
ASSISTANT WORKS CHEMIST,
WANDSWORTH WORKS.

APPLICATIONS are invited for the above- mentioned position.

Candidates should possess a University Degree or its equivalent, and should have had at least five years' experience in the technical supervision of gas works processes.

The salary will be initially within Grade X (£650-£750 per annum) of the National Salary Scales (Metropolitan Area) in respect of Administrative, Professional and Technical Staffs.

Applications in writing (quoting reference V.10/164) giving age, present occupation, experience, qualifications, etc., should reach the undersigned not later than fourteen days after the publication of this notice.

R. J. McCRAE,
Personnel Manager.

Katharine Street,
Croydon.

SOUTH EASTERN GAS BOARD

KENT COUNTY DIVISION.
GROUP ACCOUNTANT,
TUNBRIDGE WELLS GROUP.

APPLICATIONS are invited for the above- mentioned position. The selected candidate will be responsible to the Group Manager for all accounting work within the Group but excluding responsibility for Rental.

Preference will be given to applications from persons who have passed the final examination of a professional accounting body.

Subject to the possession of the necessary qualifications, the commencing salary will be within Grade XII of the National Salary Scales, Provincial "A" in respect of Administrative, Professional and Technical Staffs (£695-£820 per annum) according to experience.

Applications in writing (quoting reference V.10/165) giving age, present occupation, experience, qualifications etc., should reach the undersigned not later than fourteen days after the publication of this notice.

R. J. McCRAE,
Personnel Manager.

Katharine Street,
Croydon.

SOUTH EASTERN GAS BOARD

KENT COUNTY DIVISION
DISTRIBUTION SUPERINTENDENT,
MEDWAY GROUP
(ROCHESTER, SHEPPEY, SITTINGBOURNE & MILTON AREAS).

APPLICATIONS are invited for the above- mentioned position. Applicants should possess the Higher Grade Certificate of the Institution of Gas Engineers and have had extensive experience in both high and low pressure gas distribution. Experience in the preparation of drawings and estimates required in distribution work, including supplies for large industrial users, is essential.

The commencing salary will be within Grade X of the National Salary Scales (Provincial "A") in respect of Administrative, Professional and Technical Staffs, £620-£720 per annum, according to qualifications and experience.

Applications in writing (quoting reference V.10/141) giving age, present occupation, experience and qualifications, etc., should reach the undersigned not later than fourteen days after publication of this notice.

R. J. McCRAE,
Personnel Manager.

Katharine Street,
Croydon.

NORTHERN GAS BOARD

INTERNAL AUDIT ASSISTANT.

APPLICATIONS are invited for the appointment of INTERNAL AUDIT ASSISTANT on the staff of the Chief Accountant.

Applicants must have passed the Intermediate examination of a recognised Accountancy body.

Commencing Salary within the range £500-£580 per annum.

The successful candidate will be required to pass a medical examination, and the appointment will be subject to the provisions of such Superannuation Scheme as may be made for the Gas Industry.

Applications, stating age, experience and qualifications, giving the names and addresses of two persons to whom reference may be made, should be addressed to the Chief Accountant, Northern Gas Board, 30, Grainger Street, Newcastle-upon-Tyne, 1, to arrive not later than Saturday, June 23, 1951.

JOHN F. JACKSON,
Secretary.

May 29, 1951.

NORTH-EASTERN GAS BOARD

HUDDERSFIELD-HALIFAX GROUP.
BRIGHOUSE DISTRICT—
TECHNICAL ASSISTANT.

APPLICATIONS are invited for the post of TECHNICAL ASSISTANT (Works) at the Brighouse District at a salary in accordance with Grade VII, Provincial 'A' of the Administrative, Professional and Technical scales for the Gas Industry, *i.e.*, £500-£580 per annum.

The successful candidate will be required to pass a Medical Examination and to contribute to such Superannuation Scheme as the Board may adopt at some future date.

Applications, giving details of age, experience and qualifications, should be addressed to the Group General Manager, North Eastern Gas Board, Huddersfield-Halifax Group, Leeds Road, Huddersfield, so as to arrive not later than ten days after the appearance of this advertisement.

J. C. GARDNER,
Secretary.

Bridge Street,
Leeds, 2.
June 6, 1951.

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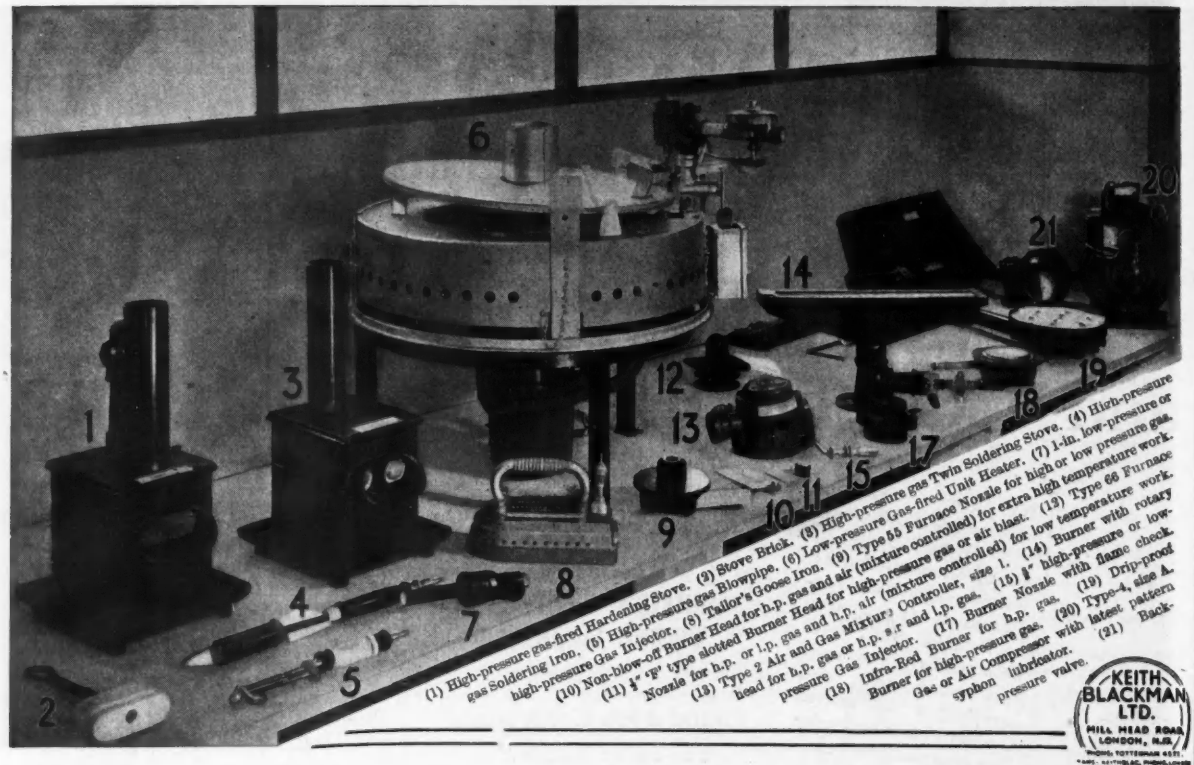

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